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NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

THESIS

**THE A. Q. KHAN NETWORK: CAUSES AND
IMPLICATIONS**

by

Christopher O. Clary

December 2005

Thesis Co-Advisors:

Peter R. Lavoy
Feroz Hassan Khan

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THE A. Q. KHAN NETWORK: CAUSES AND IMPLICATIONS

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Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF ARTS IN NATIONAL SECURITY AFFAIRS

from the

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ABSTRACT

The A. Q. Khan nuclear supplier network constitutes the most severe loss of control over nuclear technology ever. For the first time in history all of the keys to a nuclear weapon—the supplier networks, the material, the enrichment technology, and the warhead designs—were outside of state oversight and control. This thesis demonstrates that Khan’s nuclear enterprise evolved out of a portion of the Pakistani procurement network of the 1970s and 1980s. It presents new information on how the Pakistani state organized, managed, and oversaw its nuclear weapons laboratories. This thesis provides extensive documentation of command and control challenges faced by Pakistan and argues that Khan was largely a rogue actor outside of state oversight. The A. Q. Khan affair refutes more optimistic theories about the effects of nuclear proliferation. This case study indicates that states have a difficult time balancing an abstract notion of safety against pressing needs for organizational speed and flexibility. This thesis enumerates enabling institutional factors in Pakistan, which allowed Khan’s enterprise to continue and flourish, and which might also be generalizable to other states of proliferation concern.

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I. INTRODUCTION

A. INTRODUCTION

The A. Q. Khan nuclear supplier network constitutes the most severe loss of control over nuclear technology ever. For the first time in history all of the keys to a nuclear weapon—the supplier networks, the material, the enrichment technology, and the warhead designs—were out of state oversight and control. This thesis examines how Pakistan’s nuclear safety and security measures failed to prevent the transfer of secret nuclear technology. It places this command and control breakdown in the larger context of Pakistan’s nuclear history and the diffusion of nuclear technology and expertise more generally. It examines the implications of this episode for how we think about new nuclear states and the dangers of nuclear proliferation.

A. Q. Khan was largely a free actor, conducting nuclear commerce without authorization of the Pakistani state. This thesis provides evidence, where it exists, of possible Pakistani state knowledge or consent for Khan’s nuclear enterprise. However, there is no proof that the Pakistani state was aware of the nuclear transfers from Pakistan to Iran, North Korea, Libya, and perhaps others. The dangers to Pakistan were too great, the benefits too small. Instead, the most easily identifiable beneficiary was Khan, and the individuals that work with him, as evidenced in bank accounts in Pakistan, Dubai, Switzerland, and elsewhere.

Khan’s ability to forge a non-state network to transfer closely held nuclear secrets to pariah regimes is disturbing on multiple levels. First, Khan’s activities call into question the ability of Pakistan to safeguard and secure its nuclear arsenal. More generally, how well can new nuclear states gauge the internal and external threats to their new arsenals? Previous arguments that new nuclear states could control their precious nuclear assets—precisely because they were precious—may have been overly optimistic. Second, Khan’s continued operation for decades, first as an importer of nuclear technology and subsequently as an exporter, reveal weaknesses in the ability of the international community to identify and halt illicit nuclear commerce. The ability of the same individuals in Europe to operate with impunity is a costly embarrassment to

Western governments. Finally, Khan's network may reveal a more general loss of control over nuclear technology that will be difficult to reverse. Nuclear components are in the hands of many states. They were transferred through many middlemen. They were manufactured in factories from Libya to South Africa to Malaysia. Nuclear weapons designs were copied and transferred haphazardly. The barriers to entry into the nuclear world have been high. If they are lowering, we ought to be worried. Understanding Khan's nuclear commerce—and policy responses to it—are crucial to ensure that we all do better.

B. BACKGROUND

In many ways, Pakistan's acquisition of nuclear weapons was exceptional. N. M. Butt, a retired Pakistani nuclear physicist, recounts that the nuclear development took place in "an ocean of ignorance" in a country that possessed "lame high technology."¹ A. Q. Khan, the Pakistani metallurgist who played a pivotal role in Pakistan's uranium enrichment program, boasted, "A country, which could not make sewing needles, good bicycles or even ordinary durable metallised roads was embarking on one of the latest and most difficult technologies."²

Pakistan's commitment to its nuclear course was steadfast despite a tumultuous political scene: in which one civilian prime minister was executed by the military, in which one military dictator died under mysterious circumstances, and in which civilian governments are frequently deposed by presidential or military intervention. Western audiences view Pakistan's domestic politics with understandable concern. Radical religious parties hold or share power in two of Pakistan's four provinces. There are regular bombings, terrorist attacks, and sectarian feuds. In December 2003, President Pervez Musharraf narrowly survived two assassination attempts in a two-week period.³

¹ N. M. Butt, "Nuclear Developments in Pakistan," in *Arms Race and Nuclear Developments in South Asia*, ed. Pervaiz Iqbal Cheema and Imtiaz H. Bokhari (Islamabad, Pak.: Islamabad Policy Research Institute, 2004), 44.

² Peter Edidin, "Pakistan's Hero: Dr. Khan Got What He Wanted, and He Explains How," *New York Times*, February 15, 2004.

³ Salman Masood, "Pakistani Leader Escapes Attempt at Assassination," *New York Times*, December 26, 2003; "President Sees Extremists Behind Blast," *The News International* (Islamabad), December 14, 2003, <http://jang.com.pk/thenews/dec2003-daily/15-12-2003/main/main4.htm>.

Hand in hand with internal challenges, Pakistan also lives in a dangerous neighborhood. To its east, it shares a 2,000-kilometer border with a nuclear-armed India that has population, economic, and military advantages, and with which it has fought three or four wars, depending on who is counting. To its west is Iran, which harbors nuclear ambitions, and with which Pakistan has a less than cordial relationship. To the north is a literal war zone after two decades of a Pakistani policy to cultivate “strategic space” in Afghanistan collapsed on September 11, 2001. It has an unsteady alliance with the world’s remaining superpower, which already has pre-empted one Muslim country with nuclear aspirations.

Complicating matters further, Pakistan continues to weather an international imbroglio concerning the sale of nuclear weapons technology to other states. It appears that from 1987 to 2003, A. Q. Khan, head of one of Pakistan’s key nuclear organizations, was overseeing a nuclear supply network, which sold or attempted to sell to Iran, Iraq, North Korea, Libya, and perhaps others.⁴

Pakistan’s rocky domestic landscape, precarious security environment, and the A. Q. Khan scandal have led many to seriously question Pakistan’s capability and will to safeguard its nuclear arsenal. Jim Hoagland, Pulitzer-winning columnist for the *Washington Post*, was unabashed in expressing his concerns: “Pakistan continues to be the most dangerous place on Earth because of its mix of nuclear weapons, unstable politics, religious fanaticism and the involvement of senior military and intelligence officials in terrorist networks, including al Qaeda and the Taliban.”⁵ Leonard Weiss, former staff director of the Senate Committee on Government Affairs, was equally blunt: “Pakistan lied, stole, and conned its way to becoming a nuclear weapons power. Now it’s doing the same as a nuclear broker.”⁶

The controversy about Pakistan’s character, institutions, and intentions fits in a broader academic debate about nuclear proliferation. The discussion has organized into

⁴ See David Albright and Corey Hinderstein, “Unraveling the A. Q. Khan and Future Proliferation Networks,” *The Washington Quarterly* 28, no. 2 (2005): 111-128; and Christopher Clary, “Dr. Khan’s Nuclear Walmart,” *Disarmament Diplomacy*, no. 76 (March-April 2004): 31-6.

⁵ Jim Hoagland, “Nuclear Resolution,” *Washington Post*, January 8, 2004.

⁶ Leonard Weiss, “Pakistan: It’s déjà vu all over again,” *The Bulletin of the Atomic Scientists* 60, no. 3 (May/June 2004), 52.

an argument between those who think that the spread of nuclear weapons may be a positive development for international stability and those who believe that proliferation will have a deleterious impact. These contending camps are often labeled *deterrence optimists* and *proliferation pessimists*. As Peter R. Lavoy noted in his survey of this literature, “Debate over the strategic consequences of the spread of nuclear weapons is more than an academic exercise. It affects the price officials should be willing to pay for nonproliferation. This in turn influences the number and identity of states which might some day acquire nuclear weapons.”⁷

The academic debate has been theory-driven. Lavoy laments, “No thorough effort is made to test the power of either theory against the observed conduct of the actual leaders and organizations responsible for managing the nuclear forces of new nuclear states.”⁸ This is unfortunate, for the optimism-pessimism debate can be tested. Peter D. Feaver has noted that while a good theory does *not* have to explain everything, we lose confidence in a theory if it consistently fails to predict the “observable implications” of its logic.⁹ For better or worse, Khan’s prolific nuclear dealings provide extensive opportunities to test such arguments.

C. THE OPTIMISM-PESSIMISM DEBATE

The entirety of the nuclear age has been dominated by debates about whether these destructive weapons are a force of stability or a source of danger. These earlier nuclear debates were disproportionately focused on the relationship between established nuclear powers, though they had clear implications for the proliferation of nuclear explosive technology. This section draws out these implications. It concludes by arguing that we are now in the midst of a new nuclear debate. Today, the primary focus is, and ought to be, about the ability of new nuclear states to adequately safeguard and secure their nuclear deterrents.

⁷ Peter R. Lavoy, “The Strategic Consequences of Nuclear Proliferation: A Review Essay,” *Strategic Studies* 4, no. 4 (summer 1995): 696. Kenneth N. Waltz devalues the impact of U.S. policy: “Why should we think that if we relax, numerous states will begin to make nuclear weapons?” Waltz, “More May Be Better,” in *The Spread of Nuclear Weapons: A Debate Renewed* (New York: W. W. Norton, 2003), 42.

⁸ Ibid., 698.

⁹ Peter D. Feaver, “Optimists, Pessimists, and Theories of Nuclear Proliferation Management,” *Strategic Studies* 4, no. 4 (summer 1995): 766. Feaver borrows the “observable implications” concept from Gary King, Robert O. Keohane, and Sidney Verba, *Designing Social Inquiry: Scientific Inference in Qualitative Research* (Princeton: Princeton University Press, 1994), 29-30.

Within weeks of the atomic bombings of Hiroshima and Nagasaki, Jacob Viner argued that the destructive impact of nuclear weapons would deter even potentially victorious states from attacking a nuclear-armed adversary. As a consequence, the spread of such weapons might deter conflict and be a force of stability in international politics.¹⁰ Several commentators either extended or independently developed Viner's argument.¹¹ Kenneth N. Waltz presented the model argument for this optimistic view of nuclear weapons. Even a few nuclear warheads could deliver devastating damage on any target against which they were employed. An adversary's nuclear force is likely to be relatively invulnerable to a disarming strike, even a strike using nuclear forces. The mere possibility that such a deterrent force would survive and be used by a defender would outweigh any potential gains an attacker might seek.¹² Waltz and other deterrence optimists emphasized the clarity that nuclear weapons generate in cost-benefit calculations for any rational actor, anywhere.

Other commentators had a narrower focus. Some advocated permitting or facilitating the acquisition of nuclear weapons by U.S. allies to dispel any confusion about the U.S. ability to honor its extended deterrence guarantees.¹³ More recently, using similar logic, some regional analysts began to muse that the introduction of nuclear weapons into conflict-ridden regions might stabilize them.¹⁴

The deterrence optimists' lack of concern about proliferation is intimately tied up with their faith that deterrence is almost automatic once a state achieves a survivable second strike. They argue that for any state with the technical capabilities to acquire and maintain nuclear weapons, creating such a second-strike force will be possible. In the United States competition with the Soviet Union, however, this relaxed view was not held by a majority of nuclear policymakers or analysts. Deterrence was viewed as

¹⁰ Jacob Viner subsequently published an article based on comments he made at a seminar at the University of Chicago in 1945. See "The Implications of the Atomic Bomb for International Relations," *Proceedings of the American Philosophical Society*, 90 (January 1946) quoted in Lavoy, "Strategic Consequences of Nuclear Proliferation," 700-1.

¹¹ For a fuller discussion, see Lavoy, "Strategic Consequences of Nuclear Proliferation," 700-7.

¹² Waltz, "More May Be Better," in *The Spread of Nuclear Weapons*.

¹³ This was most visible in the Multilateral Force debate. See Lawrence Freedman, *The Evolution of Nuclear Strategy*, 3rd ed. (New York: Palgrave Macmillan, 2003), 309-14.

¹⁴ See Lavoy, "Strategic Consequences of Nuclear Proliferation," 706-7, fns. 39-42, and 715, fn. 68.

somewhat fragile, and new nuclear states complicated this already difficult superpower competition. Each new nuclear state complicated the picture more—and analysts labeled this “the Nth country problem.”¹⁵ Additionally, each Nth state set the stage for an N+1 country, which would complicate the deterrence calculations further.¹⁶ If new nuclear entrants could be kept at bay—perhaps through a legally binding nuclear nonproliferation treaty—strategists could focus on stabilizing the U.S.-Soviet competition.

As Bradley Thayer has noted, the nuclear debate in the United States passed through three stages.¹⁷ Initially, it focused on the vulnerability of nuclear forces to counterforce strike. This debate dominated the theoretical literature—and was reflected in U.S. nuclear force structure—from roughly 1960 to 1980.¹⁸ In the last decade of the Cold War, the “second debate on nuclear stability” focused increasing attention to the susceptibility of the United States command and control system to a decapitation strike.¹⁹ Finally, after the Cold War had largely concluded, the third wave of research concluded that the solutions the United States and the Soviet Union had put into place to solve counterforce and countercontrol vulnerabilities had significantly increased the risks of nuclear accidents and inadvertence.²⁰

To put it another way, for nuclear deterrence to generate stability, an adversary must believe that its opponent will retain a second strike capability that can inflict

¹⁵ Oscar Morgenstern, “The N-Country Problem,” *Fortune* (March 1961): 136; Fred C. Iklé, “Nth Countries and Disarmament,” *Bulletin of the Atomic Scientists* 16 (1960): 391-94; Paul Doty, “The Role of the Smaller Powers,” *Daedalus* 89 (1960): 818-30.

¹⁶ Freedman, *Evolution of Nuclear Strategy*, 288.

¹⁷ Bradley Thayer, “The Risk of Nuclear Inadvertence: A Review Essay,” *Security Studies* 3, no. 3 (Spring 1994).

¹⁸ The representative early work of this debate was Albert Wohlstetter, “The Delicate Balance of Terror,” *Foreign Affairs* 37, no. 2 (January 1959): 211-34.

¹⁹ While Herman Kahn had noted the risks of a “splendid first strike” as early as 1960, he had judged the risks to be relatively minor. Herman Kahn, *On Thermonuclear War* (Princeton: Princeton University Press, 1961), 36-37. Early works expressing concern about countercontrol strikes include Gary D. Brewer and Paul Bracken, “Some Missing Pieces of the C3I Puzzle,” *Journal of Conflict Resolution* 28, no. 3 (September 1978): 451-469; John D. Steinbruner, “Nuclear Decapitation,” *Foreign Policy*, no. 45 (Winter 1981-1982): 16-28; and Jonathan B. Tucker, “Strategic Command-and-Control Vulnerabilities: Dangers and Remedies,” *Orbis* 26, no. 4 (Winter 1983): 941-63.

²⁰ Bruce G. Blair, *The Logic of Accidental Nuclear War* (Washington, DC: Brookings, 1993); Peter Douglas Feaver, *Guarding the Guardians: Civilian Control of Nuclear Weapons in the United States* (Ithaca, NY: Cornell University Press, 1992); Scott D. Sagan, *The Limits of Safety: Organizations, Accidents, and Nuclear Weapons* (Princeton: Princeton University Press, 1993).

unacceptable damage even after a first strike is launched. Secondly, a nuclear weapons state must believe that it will not be able to limit damage to itself by launching a decapitating countercontrol first strike. (The converse of these first two conditions is also important: if a state believes it is susceptible to a disarming or decapitating strike, it may respond with a dangerous nuclear “hair trigger” posture.)²¹ Finally, nuclear deterrence is only stable if the risks of nuclear inadvertence and accidents—and as a consequence accidental nuclear war—are low.

The literature of the “third” nuclear debate focused on accidents and inadvertence. Dominated by Bruce G. Blair, Peter D. Feaver, and Scott D. Sagan, it reframed the command and control issue away from rational deterrence theory and towards organization theory. Rational deterrence theory—a natural outgrowth of structural realist expectations of state behavior—argues that the chance of nuclear retaliation will moderate state conflict and prevent nuclear war. Nuclear war is devastatingly irrational and, hence, will not occur. As Feaver has noted, rational deterrence theory viewed nuclear operations as epiphenomenal—nuclear operations will flow naturally and completely from the rationality of the nuclear weapons states.²² In Kenneth N. Waltz’s famous phrase, “We do not have to wonder whether they will take good care of their weapons. They have every incentive to do so.”²³

However, in the early 1990s, the “proliferation pessimists” argued that nuclear weapons states would have “bounded rationality.”²⁴ There were inherent limitations to the ability of organizations to learn, and these limitations were possibly more pronounced in the military commands entrusted with nuclear weapons stewardship. They induced from their understanding of U.S. near-failures during the Cold War that nuclear weapons are significantly less likely to produce strategic stability than rational deterrence theory

²¹ Peter D. Feaver, “Command and Control in Emerging Nuclear Nations,” *International Security* 17, no. 3 (Winter 1992-1993): 165. Feaver was referring solely to fears of a countercontrol strike, but a counterforce threat would also generate the same reaction. Such fears over a potential counterforce strike are precisely what motivated Wohlstetter to write, “Delicate Balance of Terror.”

²² Feaver, “The Politics of Inadvertence,” *Security Studies* 3, no. 3 (Spring 1994): 501.

²³ Waltz, “More May Be Better,” in *The Spread of Nuclear Weapons*, 21.

²⁴ Scott D. Sagan, “More Will Be Worse,” in *The Spread of Nuclear Weapons*, 51.

would indicate. These problems would be at least equally pronounced and likely greater in new nuclear states. As Thayer has summarized:

First, the emerging nuclear states will have the same trouble the superpowers had in building safe forces: the United States continued to have many accidents long after it had built a sophisticated force. Second, the nuclear forces of emerging nuclear states will be less safe than the forces of superpowers: new nuclear states will not be able to afford modern safety and warning systems, and therefore will be more prone to false warning and nuclear accidents. Also, emerging nuclear states have militaries that are more powerful relative to civilian authorities than is the case in the United States and have more turbulent civil-military relations. This will inhibit organizational learning because the incentives to protect the military will be valued over the accurate processing of information. Third, emerging nuclear states will face immediate security threats which will necessitate keeping the arsenal on a high state of alert. The tight coupling of the command and control system with the nuclear forces of the state will make the arsenal susceptible to accidents.²⁵

Feaver has framed the debate over appropriate command and control in terms of two principal dilemmas: (1) What is the proper mix of *positive* and *negative* controls? (2) What is the proper degree of *assertive* or *delegative* control for central authorities to exercise?²⁶ Positive control is the ability to launch a nuclear weapon when demanded. Negative control is the ability to prevent weapons from being launched when they are not commanded to be. The tension between positive and negative control is reflected in Feaver's always/never problem: "Leaders want a high assurance that the weapons will always work when directed and a similar assurance the weapons will never be used in the absence of authorized direction."²⁷

The mix of positive and negative controls chosen directly impacts the degree to which central authorities (in Feaver's case, civilian leaders) assert control over the nuclear arsenal or delegate that control to military authorities. The more assertive control that the leadership exercises, the higher the chances are that a decapitation strike will be successful. In other words, higher assertive control carries with it the possibility that nuclear command and control will "fail-impotent," or, more pleasantly, "fail-safe." The

²⁵ Thayer, "The Risk of Nuclear Inadvertence," 470.

²⁶ See Feaver, *Guarding the Guardians*, chap. 1.

²⁷ Feaver, "Command and Control in Emerging Nuclear Nations."

greater delegative control that is given to the military commanders, the higher the risk of accidental, unauthorized, or third-party use. The system can “fail-deadly.”

In 1997, this critique of deterrence optimism faced its own critique from a new generation of “neo-optimists.”²⁸ Implicitly, they accepted that the manner in which nuclear operations are executed—the minutiae that were largely irrelevant to earlier optimists—mattered in assessing stability.²⁹ But, they turned the proliferation pessimists’ argument on its head: “Just as minor states have disadvantages that make duplication of advanced methods of negative command and control difficult, they also have certain advantages that enable them to employ different, but comparable methods of negative command and control.”³⁰

New nuclear states are primarily concerned with regional adversaries and, as a consequence, they can capture two advantages that were denied to the superpowers, precisely because of the stunning military capabilities that the Cold War enemies had. First, these “minor proliferators” will have arsenals that are smaller and simpler than the United States and Soviet Union possessed. This significantly reduces the scale of the command and control problem. Secondly, their forces can be protected from counterforce strikes through simple methods of concealment.³¹ A necessary corollary to this is that they are protected from countercontrol attacks if individuals in control of the dispersed, concealed arsenal have been *de facto* predelegated to launch in the event of a decapitation strike.³²

This outline of the optimism-pessimism debate allows us to extrapolate to specific predictions of how new nuclear states are likely to arrange their command and control systems. Pessimists fear that new nuclear states will create nuclear forces that are

²⁸ Jordan Seng, “Less is More: Command and Control Advantages of Minor Nuclear States,” *Security Studies* 6, no. 4 (Summer 1997): 50-92; David J. Karl, “Proliferation Pessimism and Emerging Nuclear Powers,” *International Security* 21, no. 3 (Winter 1996–1997): 87-119. Thayer, “The Risk of Nuclear Inadvertence,” foreshadows several “neo-optimist” arguments.

²⁹ Feaver notes this in his critique of neo-optimism. “Neo-optimists and the Enduring Problem of Nuclear Proliferation,” *Security Studies* 6, no. 4 (Summer 1997): 93-125.

³⁰ Seng, “Less is More,” 62

³¹ *Ibid.*, 63.

³² Seng never seriously deals with the countercontrol problem. Operational flexibility, while somewhat mitigating the countercontrol problem, does not eliminate it. Seng, “Less is More,” 75.

susceptible to counterforce or countercontrol strikes.³³ As a consequence, they worry that such nuclear newcomers will be forced to place nuclear forces on a high state of alert. Given poor early warning and command and control technology, these new nuclear states are likely to encounter grave dangers from such a “tight coupling” between the system’s stimulus and response.³⁴ Because of the significant command and control challenges, pessimists believe that nuclear decisions may be predelegated to lower level commanders, raising the risk of accidental nuclear war if one of those commanders determines the conditions of his predelegated authority have arisen or from the “crazy colonel” problem.³⁵ Finally, pessimists worry about safety and security issues. They are concerned that the relative ignorance of new nuclear states increases the chance for nuclear accidents, particularly during crisis and conflict.³⁶ Further, they worry that the domestic instability of new nuclear states may weaken controls the government has over its nuclear arsenal.³⁷

Optimists, on the other hand, predict that relatively simple concealment and mobility measures can ensure the survivability of new nuclear arsenals.³⁸ Because such arsenals can ride-out an adversarial first strike, they will not face the lose-them-or-use-them situations that led the superpowers to launch-on-warning postures during the Cold War. Further, they would not have the necessary early warning or command and control capabilities to launch-on-warning even if they did so desire.³⁹ The smaller size of the arsenal will decrease, *ceteris paribus*, the chance of accidents compared to the huge arsenals of the superpowers.⁴⁰ This smaller size and lower sophistication is also likely to

³³ Sagan, “More Will Be Worse,” 64-5.

³⁴ Ibid., 79.

³⁵ Ibid., 79-81; Feaver, “Neo-optimists and the Enduring Problem of Nuclear Proliferation,” 110-2.

³⁶ Sagan, “More Will Be Worse,” 78-9; Feaver, “Neo-optimists and the Enduring Problem of Nuclear Proliferation,” 101-2.

³⁷ Sagan, “More Will Be Worse,” 81-2; Feaver believes that domestic instability has cross-cutting effects, see “Neo-optimists and the Enduring Problem of Nuclear Proliferation,” 112-5.

³⁸ Waltz, “More May Be Better,” 20-26; Seng, “Less is More,” 68-71.

³⁹ Ibid., 67-8; Michael Quinlan, “Book review of *Escalation Control and the Nuclear Option in South Asia*,” *Survival* (Spring 2005): 190. Quinlan might not place himself in the optimists’ camp, but on this specific issue, he concurs with them.

⁴⁰ Seng, “Less is More,” 70.

dampen the “tight coupling” that might lead to dangerously rapid action-reaction cycles.⁴¹ Additionally, the smaller size will mean less individuals will have to guard the arsenals, and that those individuals can be more closely screened. Ensuring the loyalty of the nuclear guardians will be further helped by more relaxed views of domestic espionage likely to be held in new nuclear weapons states.⁴²

The pessimists appear to be worried about the wrong thing. Their concerns about command and control in new nuclear weapons states were principally based on their concerns about command and control during the U.S.-Soviet confrontation. The dangers of a launch-on-warning posture for South Asia are presently non-existent because neither Pakistan nor its principal adversary, India, have developed such a posture. Both states have undeniably increased readiness levels since the 1998 nuclear tests, but not nearly to the extent predicted by the most pessimistic observers. The optimists were correct that new nuclear states would be able to develop survivable basing modes. It would be nearly impossible for India to eliminate all of Pakistan’s mobile missile platforms in any prospective first strike. However, the mobility “solution” to the survivability “problem” significantly compounds the command and control challenge, something the optimists do not fully acknowledge.

This thesis explores one portion of the optimism-pessimism debate: that relating to the ability of new nuclear states to secure their nuclear arsenals from insider threats. The academic debate has not ignored the challenges posed by bad actors. Herbert L. Abrams has examined the dangers posed by mentally unstable individuals with access to nuclear weapons.⁴³ Jessica Stern and Gregory Koblentz have observed the potential tension between measures designed to improve stability between states and measures designed to secure weapons from insider threats.⁴⁴ This stability-security tradeoff is a reflection of Feaver’s broader always-never dilemma. Scott D. Sagan has described

⁴¹ Karl, “Proliferation Pessimism and Emerging Nuclear Powers,” 112-3; Seng “Less is More,” 74-77.

⁴² Waltz argues that the rationality of the states will ensure safety and security, “More May Be Better,” 21. The more sophisticated neo-optimist argument is in Seng, “Less is More,” 70, 81-4.

⁴³ Abrams, “Human Reliability and Safety in the Handling of Nuclear Weapons,” *Science and Global Security* 2 (1991): 325-349.

⁴⁴ Stern and Koblentz, “Preventing Unauthorized Access to and Use of Nuclear Materials and Weapons: Lessons from the United States and Former Soviet Union,” paper presented to the CISAC Workshop on Preventing Nuclear War in South Asia, Bangkok, August 4-7, 2001.

“how efforts to improve nuclear security can inadvertently backfire, increasing the risks they are designed to reduce.”⁴⁵ For instance, by increasing the number of guards at a nuclear facility, there are more opportunities for a terrorist to become a guard.

The A. Q. Khan affair provides a particularly significant case study of an insider threat. The optimist argument recognized that state institutions in new nuclear states were likely to have greater relative power over a normal individual. Authoritarian or semi-authoritarian regimes would be able to exert greater control over individuals that had access to nuclear secrets, they argued, in part because these regimes could dispense with niceties like due process and civil liberties.⁴⁶ While this insight is correct, the Khan episode indicates that senior officials may have greater autonomy in authoritarian or semi-authoritarian regimes. Institutional checks-and-balances may not function, particularly in the context of secret and sensitive national security issues.

As will be discussed in greater detail below, the extent of state authorization of A. Q. Khan’s nuclear dealings is debatable. The available evidence seems to indicate that Khan was largely a rogue actor, acting without the approval of the state writ large. State knowledge and authorization is not a binary issue, however. The available evidence is scant and ambiguous. This thesis will necessarily be forced to resort to educated conjecture at points. Nevertheless, there does appear to be evidence that key Pakistani officials *may* have been predisposed to authorize *limited* nuclear cooperation with Iran in the late 1980s. Further, nuclear transactions with North Korea may not have been strongly opposed in the context of a much broader strategic relationship between Islamabad and Pyongyang—even if such transactions were not explicitly authorized by the state. However, it is Khan’s nuclear dealings with Libya that indicate the highest degree of nuclear free-lancing. The benefits to the Pakistani state are unclear, while the benefits to Khan as an individual are obvious.

This set of facts leads us toward the pessimist’s camp for three reasons—and *it leads us to the pessimists’ camp even when we consider multiple interpretations of the Khan episode.* First, if there was state knowledge of Khan’s nuclear dealings,

⁴⁵ Sagan, “The Problem of Redundancy Problem: Why More Nuclear Security Forces May Produce Less Nuclear Security,” *Risk Analysis* 24, no. 4 (2004): 936.

⁴⁶ See fn. 42.

assumptions of state rationality by Waltz and Seng may not be as binding as the optimists had hoped. The Pakistani state, if it were aware of Khan, would have held a remarkably narrow view of Pakistan's national interest. A rational nuclear weapons state does not offer to transfer nuclear technology to likely adversaries (Iran) or the adversaries of key allies (Iran and Iraq) or to countries of marginal importance (Libya). Such behavior is certain to draw the ire of friend and foe alike. The transfer of nuclear technology to Tehran, in particular, has significantly complicated Pakistan's regional security picture. This scenario ought to be troubling for optimists, because under it, Pakistan would not have appeared to take particularly good care of their nuclear technology, despite having every incentive to do so.

If the state did not know or authorize Khan's nuclear moonlighting, this also reinforces the pessimist argument. Realist assumptions of state rationality are rendered moot because of the key role of the non-state actor. The ability and willingness of the Pakistani state to safeguard and secure its nuclear technology are called into deep question. By implication, the ability and willingness of other new nuclear states is also challenged.

Finally, under either scenario, the optimist argument is indirectly challenged. Such nuclear transfers have the potential to significantly ease the path of nuclear aspirants to an explosive device. A key plank of the optimist argument is that the difficulty of acquiring a nuclear device will sort out the most chaotic and unreliable states. In other words, the ability to adequately secure nuclear technology was viewed by optimists as only a moderately challenging task. The far more challenging task of acquiring a nuclear arsenal would screen out those technologically and organizationally deficient states. To the extent that proliferation supplier networks ease the path to a nuclear arsenal—an open question for sure—the screening mechanism is weakened. Waltz has argued that even this weaker threshold will not qualitatively change the situation: “Although some of the new nuclear states may be economically and technically backward, they will either have expert and highly trained scientists and engineers or they will not be able to produce nuclear weapons. Even if they buy or steal the weapons, they

will have to hire technicians to maintain and control them.”⁴⁷ Waltz is stretching, however. Competent technicians and scientists are readily available—witness the number of competent members of the Japanese cult Aum Shinrikyo. The difficulties of manufacturing a nuclear explosive device are not the personnel with knowledge, but the huge engineering and industrial challenge of creating fissile material. To the extent the challenges of that task are lessened, less capable, less competent, and less stable states will be able to enter the nuclear business.

Examining the A. Q. Khan affair also points to six different conditions that enabled or eased his illicit nuclear activities. Many of these conditions could be replicated in other new nuclear states.

1. The Norm of Norm Defiance

New nuclear states are likely to have actively opposed or circumvented the nuclear nonproliferation regime for decades. Though the process of norm creation is poorly understood, it seems likely that actively challenging a norm is likely to lead to the creation of counter-narratives among key actors in the acquiring state. Internalizing nonproliferation logic would de-legitimize the nuclear enterprise for a nuclear aspirant. Evidence of such a counter-narrative can be found in Khan’s stated desire to pierce the “clouds of so-called secrecy” that the non-proliferation regime sought to create.⁴⁸ India’s statement that its test was a blow “against nuclear apartheid” also captures this sentiment, even if Delhi’s actions did not attack the nuclear regime from as many directions as Khan’s subterranean nuclear dealings.⁴⁹

2. The Uranium Route

There are two routes to the acquisition of fissile material necessary to develop nuclear weapons: uranium enrichment or plutonium production. Plutonium production requires the acquisition of large-scale facilities: most importantly a nuclear reactor and a plutonium reprocessing plant. These facilities can only be acquired from a few sources globally. They are large, difficult to construct, and easy to observe. There are a number

⁴⁷ Waltz, “More May Be Better,” 21.

⁴⁸ William J. Broad, David E. Sanger, and Raymond Bonner, “A Tale of Nuclear Proliferation,” *New York Times*, February 12, 2004.

⁴⁹ See Jaswant Singh, “Against Nuclear Apartheid,” *Foreign Affairs* (September-October 1998): 41-52.

of ways to enrich uranium: gaseous diffusion, gas centrifuge, aerodynamic nozzle, chemical, laser, and electromagnetic.⁵⁰ Pakistan was one of the first developing countries to employ gas centrifuge technology to enrich uranium. This technology uses thousands of centrifuges spinning at extremely high speeds to separate uranium isotopes of different density. The key point is that rather than the few large facilities of the plutonium route, a country pursuing gas centrifuge technology would need to acquire nearly a hundred components each for thousands of centrifuge. Since a majority of these components cannot be easily manufactured, and because a majority of these components are proscribed by export control regimes, this necessitates a massive illicit procurement effort. States that successfully develop gas centrifuge enrichment must develop a network to funnel cash, often through middlemen, to shady businessmen. They then must transport the components from their point of origin, often relying on false end-user certificates and other techniques to deceive law enforcement and intelligence agencies. These goods are often transported through multiple third-party countries to further confuse watchful eyes before finally arriving in their destination. All of these techniques to procure can be used to proliferate. Further, bureaucrats and scientists involved with large, poorly documented cash transactions may quickly be corrupted by the process. When playing in mud, one gets dirty. This problem is present in all illicit procurement, but seems to be particularly acute because of the logistical challenges of assembling a centrifuge cascade.

3. Covert Weapons Programs

Pakistan sought to acquire nuclear weapons by circumventing an increasingly elaborate global nonproliferation regime and in defiance of potential U.S. sanctions. All the while Islamabad faced significant military threats from India, a neighbor that had already tested nuclear weapons, and perceived a potential military threat from extraregional actors, particularly Israel. It was critical that the Pakistani nuclear program remain largely hidden from public scrutiny. Throughout the 1980s, the existence of the Pakistani nuclear weapons program became a more open secret. Nevertheless, the political classes in Islamabad and Rawalpindi could not publicly acknowledge a nuclear weapons infrastructure that their leadership denied existed. Their ability to regulate this

⁵⁰ Allan S. Krass, et al, *Uranium Enrichment and Nuclear Weapon Proliferation* (London: Taylor & Francis, 1983), 18-22.

program was significantly constrained during these most guarded years. As Peter D. Feaver has noted, “Organizational theorists have long maintained that knowledge is power. By restricting knowledge, power is also restricted.”⁵¹ This secrecy still imbues most aspects of the Pakistani program. Even today, few military officers or civilian officials have a detailed understanding of Pakistan’s nuclear weapons infrastructure or its operational planning. Even fewer are willing to question the procedures put in place to safeguard the nation’s nuclear secrets. One imagines that nuclear decisions are also closely guarded in Tehran, Pyongyang, and perhaps other capitals, with similarly stultifying effects on potential regulators.

4. Weak Institutions and Personalized Rule

Power in Pakistan remains highly personalized. Power is distributed unevenly between the prime minister, president, and chief of army staff. The nuclear weapons program was initiated under President Zulfikar Ali Bhutto in January 1972. During his tenure, first as president and then as prime minister, the nuclear weapons program was under his direct control, through a few trusted aides in the military, foreign office, and strategic organizations. Upon his ouster in 1977, Gen. Muhammad Zia-ul-Haq attempted to institutionalize nuclear control. He established a committee composed of select cabinet members, a military representative, and the heads of the strategic organizations themselves. Even so, it appears this committee was a largely *ad hoc* body, with a rotating membership, few if any staff, and very circumscribed institutional memory. The longest serving members on the committee appear to have been the heads of the Pakistan Atomic Energy Commission (PAEC) and Khan Research Laboratories (KRL), who had strong bureaucratic reasons to skew the institutional memory they shared with their counterparts. After Zia’s death in 1988, the military retained primary responsibility for the nuclear weapons program, selectively informing presidents and prime ministers about the program based on their perceived trustworthiness and the political alignment of the day. Within the military, more formal organizations were created to examine the details of nuclear development and operations. After the May 1998 nuclear tests, it was possible to more openly discuss the nuclear weapons program. Organizational growth followed the May tests, leading to the creation of the Strategic Plans Division (SPD) in 1999 and the

⁵¹ Feaver, *Guarding the Guardians*, 246. Also see Sagan, *Limits of Safety*, 209-10.

announcement of a National Command Authority in 2000. It was not until the creation of SPD in 1999 that a competent and persistent institution could encroach on the institutional autonomy of the PAEC and, to an even larger extent, KRL. Complicating matters further, all of this was occurring in an environment of intense politicization. An increase in civilian influence meant a loss of authority by the military. An increase in responsibilities for PAEC was viewed in zero-sum terms by KRL. Other new nuclear states are likely to have anarchic domestic political institutions, accompanied with intense bureaucratic rivalries.⁵²

5. A Weak Shadow of the Future

Throughout the 1970s and 1980s, Pakistani strategic planners worried about an existential threat from neighboring India. Having lived through the vivisection of Pakistan in 1971, Pakistani elites may have focused on today's threat rather than on potential future risks. As noted previously, oversight institutions may not have had the institutional capacity to accurately judge risks and were overly reliant on the organizations they were supposed to regulate. This only further weakened the shadow of the future, as the organizations had strong bureaucratic reasons to downplay the risk. Strategic organizations, particularly Khan Research Laboratories, were given greater autonomy and flexibility so that they could deploy a credible nuclear deterrent more quickly.

6. The Limits of Vicarious Learning

Sagan has extensively demonstrated the limitations that organizations face as they attempt to learn from past trial-and-errors.⁵³ In a way, the Khan affair is a more challenging problem than imperfect learning. Pakistani elites had to anticipate that a national hero would betray vital secrets for personal gain. In order to prevent Khan's nuclear dealings, they would have had to restrict significantly Khan's autonomy over personnel, finances, logistics, and transport. The ability of Pakistani strategic planners to learn from the experience of other nuclear states would have been constrained for three reasons: (1) the secrecy that surrounded nuclear operations, even in the United States,

⁵² See Sagan's discussion of this category of problems in *The Limits of Safety*, 29-30, 42, 255-6.

⁵³ Ibid. For introductions to organizational learning, see George P. Huber, "Organizational Learning: The Contributing Processes and the Literatures," *Organization Science* 2, no. 1, *Special Issue: Organizational Learning: Papers in Honor of (and by) James G. March* (1991): 88-115; and Barbara Levitt and James G. March, "Organizational Learning," *Annual Review of Sociology* 14 (1988): 319-40.

until the mid-1980s; (2) the lack of institutional capability within Pakistani state structures to carry out such vicarious learning attempts; and (3) the poor analogy of outside experiences to the type of threat Khan would pose. In other words, the mistakes others made were largely secret, Pakistan was not actively seeking to learn from those mistakes, and the mistakes Pakistan was about to make were quite unique!

D. PREVIEW

This thesis examines the interplay of these six conditions in the confusing, disturbing, and fascinating tale of A. Q. Khan. It places A. Q. Khan in the context of the Pakistani nuclear weapons procurement effort. It examines three case studies in an attempt to understand different aspects of Khan's proliferation enterprise. Finally, it concludes with an examination of policy implications for the United States.

1. From Illicit Procurement to Proliferation

This chapter examines the overall Pakistani nuclear weapons effort, and A. Q. Khan's role in it. Khan returned to Pakistan from Europe in 1976. He brought back knowledge of uranium enrichment technology and suppliers at an auspicious time for Khan and the Pakistani state. The Pakistan Atomic Energy Commission had undergone prolonged, multi-year negotiations for a plutonium reprocessing plant, and the Pakistani leadership was increasingly concerned with the ability of the PAEC to deliver. Khan prodigiously set about creating a procurement system to gather nuclear-relevant components and materials from around the world in order to construct a scientific and engineering infrastructure that would provide fissile material for Pakistan and fame to Khan. Further, Khan was able to operate with fewer bureaucratic constraints, because the Pakistani state was wary of hobbling Khan as it had with the PAEC. This chapter highlights how Khan was able to establish a network for procurement that he would subsequently use for proliferation. It also emphasizes how Khan's institutional autonomy, gained in these early years, allowed him to avoid oversight and control during two decades of illicit nuclear deals.

2. The First Time is Special: Khan's Assistance to Iran

Khan's first nuclear sale appears to have been to Iran. Chapter 2 discusses a unique constellation of actors within the Pakistani leadership who may have been predisposed to give Khan wide autonomy, particularly when it came to his dealings with

Iran. It explores the scope and timeframe of Khan's cooperation with Iran. Finally, it assesses how significant Khan's transfers were to Tehran's broader nuclear effort.

3. The Problem of Background Noise: Khan's Assistance to North Korea

This chapter summarizes the publicly available information about what was transferred to North Korea and how significant such transfers might be. Many analysts assume that given Pakistani-North Korean cooperation on missile technology, any nuclear cooperation must have occurred with the knowledge of Pakistani state authorities. This chapter demonstrates that a nuclear-for-missile technology exchange, while possible, is not the only way to read the Pakistani-North Korean relationship. It offers alternative, but unproven, explanations. It examines the prospect that North Korea might have provided plutonium or plutonium expertise to Pakistan. It looks at evidence suggesting Pakistan may have assisted North Korea with uranium conversion, suggesting broad state-to-state nuclear cooperation. It concludes by arguing that none of the state-level explanations are entirely compelling, and more weight should be given to individual or institutional rationales for Khan's assistance to Pyongyang.

4. Tragic Ambition: Libya and Nuclear Off-Shoring

This chapter describes Khan's growing network of friends, collaborators, and middlemen. It discusses how Khan launched his most ambitious effort yet: his attempt to "off-shore" the production of key nuclear components to assist Libya. Such an attempt would be a massive manufacturing and logistical challenge. Firms from as far away as Turkey, South Africa, and Malaysia were involved in the effort. The audacious plan opened up Khan's network to penetration by foreign intelligence agencies, and prepared the way for Khan's downfall.

5. Conclusion

This thesis concludes by discussing U.S. policy and intelligence failures in confronting the Khan network. It examines the degree to which Khan was unique or representative of a growing pernicious threat. Finally, it provides specific indicators to U.S. policymakers and analysts as they assess the risk that other nuclear procurement programs will have Khan-like entrepreneurs.

E. CONCLUSION

Former Director of Central Intelligence George Tenet has described Khan as being “at least as dangerous as Osama bin Laden.”⁵⁴ Yet for almost two decades, Khan’s danger was hiding in plain sight. Beginning in the early 1990s, reports were percolating through the U.S. intelligence community that Khan was assisting other countries with their nuclear programs. Alarm bells should have been going off in Islamabad as Khan ventured to foreign capitals and amassed more wealth. This thesis chronicles the story of one man’s remarkable ability to avoid getting caught, and lessons all of us should learn to prevent the recurrence of such a danger.

⁵⁴ Douglas Jehl, “CIA Says Pakistanis Gave Iran Nuclear Aid,” *New York Times*, November 24, 2004.

II. FROM ILLICIT PROCUREMENT TO PROLIFERATION

A. INTRODUCTION

Abdul Qadeer Khan's proliferation network is a corrupted portion of a procurement system created by Pakistan in the 1970s and 1980s. Neighboring India significantly complicated Pakistan's nuclear effort. India's 1974 "peaceful nuclear experiment," where it detonated a nuclear explosive device at the Pokhran test site, alerted the world to the dangers of a free flow of nuclear information. Led by the United States, the Western supplier cartels significantly strengthened the controls on the spread of key technologies. At the same time, India's test made Pakistan's quest for the bomb even more desperate.

This chapter highlights how Pakistan recovered from serious setbacks in its bomb-making enterprise, circumvented Western export controls, established a procurement system, and slowly developed an indigenous infrastructure to create an atomic bomb. It introduces several themes that appear subsequently in this thesis. It emphasizes how the same skills necessary to illicitly procure are used in illegal proliferation. It discusses how even motivated Western bureaucracies were slow to respond to an increasingly visible threat. Finally, it introduces a fierce rivalry between Khan's organization and the Pakistan Atomic Energy Commission.

In order to succeed, Pakistan felt that it was necessary to give Khan Research Laboratories greater autonomy and flexibility than was the bureaucratic norm. Illicit procurement is a complicated and corrupting enterprise. In the end, the flexibility essential for the success of Pakistan's acquisition efforts also enabled Khan's exports. This is the tragedy of the A. Q. Khan affair. It also indicates that a state may value speed, secrecy, and success over more abstract concepts of safety and control.

B. OUTRACING THE NONPROLIFERATION REGIME

Khan did not create the world marketplace for dual-use and proscribed goods, but he was the most successful individual ever to tap into it. Perhaps an Indian magazine was more correct than it could have known when in 1987 it described Khan as a cross

between Dr. Strangelove and “an Islamic James Bond.”⁵⁵ Khan had been enmeshed in the European nuclear scene during the 1960s and 1970s.⁵⁶ He studied briefly in Germany at West Berlin’s *Technische Universität*, received a master’s degree in metallurgical engineering at the *Technische Hogeschool* in Delft, the Netherlands, and received his doctorate in metallurgy from the Catholic University of Leuven in Belgium. His professors and fellow graduate students were a helpful resource to Khan throughout the 1970s, though many of them cut off contact with Khan after formal government investigations were launched. Some of his contacts, however, would continue to associate profitably with Khan until quite recently.

From May 1972 to December 1975, Khan worked for Fysisch Dynamisch Onderzoekslaboratorium (FDO, or Physical Dynamic Research Laboratory), a subsidiary of Verenigde Machinefabrieken (VMF, or United Machine Factory). FDO was a major subcontractor to Ultra-Centrifuge Nederland (UCN), which itself was the Almelo-based contractor to the Anglo-Dutch-German uranium enrichment consortium, URENCO. While at FDO, though only cleared to have access to “confidential” information, he regularly had access to materials of higher classification at FDO, UCN, and Fijn Mechanische Afdeling (FMA, or Fine Machine Department), another VMF subsidiary. In fact, he spent several days translating classified German reports on ultracentrifuge developments into Dutch. He was permitted to take entire files home from work, so that his wife, a Dutch-speaking South African, could assist him in translations. In at least one instance, he was observed writing notes in Urdu, which he explained away as a personal letter, unrelated to his work.

By early fall 1975, however, the Dutch authorities had grown concerned about the number of suspicious incidents involving Khan. He was removed from work on gas

⁵⁵ “Pakistan’s Nuclear Bombshell,” *India Today*, March 31, 1987, reproduced in John G. Dean, U.S. Embassy, Delhi, “Article on the Pak Nuclear Program,” Unclassified, Cable, 07381, March 25, 1987, Digital National Security Archive, no. NP02444.

⁵⁶ This section of Khan’s life is documented in Report of the Government of the Netherlands on the “Khan Affair,” to the Tweede Kamer, reproduced in “Dutch Government Report,” in Sreedhar, ed., *Pakistan’s Bomb: A Documentary Study*, 2nd ed. (New Delhi: ABC Publishing, 1987), 114-157; Zahid Malik, *Dr. A. Q. Khan and the Islamic Bomb* (Islamabad, Pak.: Hurmat, 1992), 52-57; Steve Weissman and Herbert Krosney, *The Islamic Bomb* (Delhi: Vision Books, 1983), 186-97; and Joop Boer, et al, *A. Q. Khan, Urenco, and the Proliferation of Nuclear Weapons Technology* (Greenpeace International, May 2004), 9-10.

centrifuge development in October and, shortly thereafter, went home to Pakistan on vacation. He never returned to work, and resigned his position in March 1976. Khan had been asked by Zulfikar Ali Bhutto, Pakistan's prime minister, to stay in Pakistan and assist in the nuclear weapons effort.⁵⁷ He brought with him stolen centrifuge designs and, perhaps more importantly, a list of dozens of companies that supplied centrifuge parts and materials. After a brief stint within the Pakistan Atomic Energy Commission structure, he moved to the Engineering Research Laboratories, setting up a uranium enrichment plant in Kahuta. Within four years of returning home, his progress was significant enough that then-President Zia ul-Haq renamed the facility. Khan Research Laboratories (KRL) was born.

As head of KRL, A. Q. Khan would report directly to the president.⁵⁸ Initially, KRL would be in charge of one component of the larger nuclear puzzle: enriching gaseous uranium hexafluoride into weapons-grade material. The rest of the process—from mining to yellowcake to gasification and back again from gas to metal to milling and weapons fabrication—was under the control of the Pakistan Atomic Energy Commission.⁵⁹ As will be discussed in more detail later in this chapter, both organizations competed fiercely for resources. As KRL pushed out, it inevitably bumped into PAEC's area of responsibility, only raising the stakes of the bureaucratic infighting. Over time, KRL would gain a sanctioned role in developing delivery vehicles for the nuclear device as well as increasing (and possibly unsanctioned) involvement in the machining, fabrication, and assembly of a nuclear device.

Almost immediately upon his return to Pakistan, Khan began to gather as many components and as much information as he could from the network he had established during his decades abroad. He contacted former co-workers, inquiring about difficult

⁵⁷ Malik, *Dr. A. Q. Khan*, 58-63; and "Unknown Facts about the Reprocessing Plant," [Maulana Kausar Niazi, *Aur Line Kat Gayee*, trans. by Samuel Baid (Pak.: 1987), chapter 9,] in *Pakistan's Bomb*, 358-362.

⁵⁸ At this time, Gen. Zia-ul-Haq was also the Chief of Army Staff.

⁵⁹ Interview with Pakistani military official, June 2004; also see remarks by President Pervez Musharraf regarding Khan's limited technical expertise outside of uranium enrichment. David Brunnstrom, "Interview: Dirty Bomb a Fear, Not Nuclear Terrorism – Musharraf," *Reuters*, April 14, 2005.

technical processes and urging them to visit Pakistan, where he could arrange for technical consulting.⁶⁰ One FDO employee reportedly did travel to Pakistan in 1976.⁶¹

Pakistani firms or embassy personnel contacted several Dutch firms about purchasing specialized components. Many of these goods were shipped to Pakistan, slipping through the porous export controls of several European countries. Even as the Dutch government was investigating the A. Q. Khan affair, one Dutch company was manufacturing and shipping thousands of tubes made of a “special hard type of steel.” The frustration and impotence of the Dutch authorities is evident in the government report to the national legislature: “The great majority of it has been exported... despite repeated oral and written warnings not to do so.”⁶² Other Dutch firms sold more tubes to Pakistani firms. Some were made out of aluminum. More blatantly, a large order was made for high-carbon, low-corrosion martensitic steel, an alloy used almost exclusively for jet engines and gas centrifuges.

This was part of a broader and clear Pakistani strategy. Khan later said, “I took full advantage of the willingness of western companies to do business and decided to make purchases from the open market.”⁶³ In Switzerland, Pakistan purchased key components for a uranium enrichment capability, including a massive unit to gasify and solidify uranium hexafluoride so they could be fed into the centrifuges, as well as high-vacuum valves. In Germany, Pakistani diplomats purchased vacuum pumps and gas purification equipment, along with rolled rods and thousands of specially welded aluminum parts. In France, Pakistani buyers may have been able to buy bellows for ultracentrifuges by routing the shipment through Belgium and away from stricter French customs officials. In Britain, Pakistan purchased high-frequency inverters through a British front company, sometimes using a West German commission agent.⁶⁴

Khan’s timing could hardly have been better. When Zulfikar Ali Bhutto initiated the nuclear weapons program in 1972, he also appointed a new head for the Pakistan

⁶⁰ “Dutch Government Report,” *Pakistan’s Bomb*, 135.

⁶¹ Weissman and Krosney, *The Islamic Bomb*, 201.

⁶² “Dutch Government Report,” *Pakistan’s Bomb*, 136.

⁶³ Malik, *Dr. A. Q. Khan*, 75.

⁶⁴ Weissman and Krosney, *The Islamic Bomb*, 199-206.

Atomic Energy Commission (PAEC). Dr. Munir Ahmad Khan had worked for the International Atomic Energy Agency on nuclear power projects since 1958—an association that would be used occasionally to question his support of the Pakistani nuclear weapons effort. Munir Ahmad Khan's PAEC initiated Pakistan down a plutonium route for nuclear weapons production. But after India's nuclear test in 1974, the international community took decisive action to ensure that Pakistan would not follow India's lead. Canada refused to supply nuclear fuel, heavy water, or spare parts for the continued operation of the Karachi Nuclear Power Plant (KANUPP).⁶⁵ The Ford administration put intense pressure on Germany and France to stop cooperation with Pakistan, leading quickly to a Germany agreement to halt construction of a heavy-water production facility. After initially delaying, France also abandoned an agreement to build a plutonium reprocessing facility for Pakistan in 1978.

Many in the Pakistani government were angry and upset over the failure along the plutonium route. They were angry with the international community, first and foremost. Pakistan was being punished for India's sins. Further, they argued that Canada's refusal to supply KANUPP was a violation of its agreement with Pakistan, an agreement that had been validated by the International Atomic Energy Commission. If Canada could defy its commitments to the agreement, Pakistanis argued, then Pakistan could ignore the safeguards to which it had agreed. The line of analysis remained theoretical, since Pakistan was wary of the international response to such a course of action. Finally, though, the Pakistani establishment was upset at PAEC for failing to succeed. The negotiations had been interminable with France, and the price had been escalating constantly. Bureaucrats at PAEC and in the Finance Ministry were blamed for dithering and nitpicking. Next time, the lesson was learned, Pakistan must do it more quickly, before the window closes.

The three body blows to the PAEC occurred at the same time that A. Q. Khan returned to Pakistan with his centrifuge designs and connections. As Ashok Kapur has noted,

⁶⁵ For a detailed description of the challenges this created, see Munir Ahmad Khan, "How Pakistan Made Nuclear Fuel," parts 1 and 2, *The Nation* (Lahore), February 7 and 10, 1998, FBIS-FTS19980211000724 (posted February 11, 1998).

A. Q. Khan's approach was innovative. In the reprocessing route, Pakistan's approach was to acquire a major facility, e. g. a reprocessing plant, and to deal with the major nuclear suppliers. A. Q. Khan's approach was entirely different—viz. to get bits and pieces (components) of enrichment technology and equipment from small, high technology Western firms who deal with individual components; to bring the components together so as to achieve mastery over the enrichment cycle—from acquisition of yellowcake, gasification/solidification units and centrifuges to their operation; and to do the design work and the assembly of imported components in Pakistan by Pakistanis with some foreign technological assistance by selected foreign personnel from Europe and North America.⁶⁶

Martin J. Brabers, Khan's old professor from the University of Leuven, explained Khan's success. "[I]n buying equipment, he knew all the companies, he knew so many people abroad in many countries.... Why, he knew so many languages, and he is so charming [that] he managed to buy many things that other Pakistanis would not manage to buy."⁶⁷

Khan and his network were working against time. The export control system was initially ignorant of the threat and then lethargic in reacting against it. From the beginning of Pakistan's buying spree, the red flags were raised one by one. In Switzerland, the Pakistani buyers asked specifically for high-vacuum valves for a centrifuge enrichment plant. There was no attempt to hide the intent, but the London Club of nuclear exporters had not placed such high-vacuum valves on the "trigger list" of restricted exports, and so their sale proceeded. The gasification and solidification unit—again with a clear nuclear intent and again not controlled by the supplier cartel—also left Switzerland, without even the requirement of an export permit. The unit was so large it had to be hauled away in three specially chartered C-130 transport planes. As mentioned above, the Dutch government attempted to stop a large order of hardened steel tubes, only to be ignored by the Dutch supplying firm. After the first shipment of British high-frequency inverters, Pakistani engineers sent an extended message requesting extensive and complex modifications to the finished product. This sophistication only further undermined

⁶⁶ Ashok Kapur, *Pakistan's Nuclear Development* (New York: Croom Helm, 1987), 205.

⁶⁷ Weissman and Krosney, *The Islamic Bomb*, 198.

Pakistan's cover story that the inverters were for a textile factory.⁶⁸ Reflecting back, Khan noted the eagerness of European firms to do business with the Pakistani program and to respond to its needs: "They literally begged us to buy their equipment. We bought what we considered suitable for our plant and very often asked them to make changes and modifications according to our requirements."⁶⁹

Pakistan's supply of luck was large, but not limitless. People were starting to notice. As governments were pressed from inside and out to control this trade in nuclear sensitive goods, they slowly roused themselves to the task. A British member of parliament, Frann Allaun, raised the issue of inverters in the press and on the floor of parliament. He noted, "These converters are of the same kind, and have the same frequency, as those ordered by the British Atomic Energy Authority.... They are unsuitable as a control system in a textile factory."⁷⁰ The shipment of inverters, however, took place after Allaun had first voiced his concern. The British government could not re-examine its export controls in time to stop the shipment.

But the doors were closing for Pakistani procurement agents. While British inverters were on their way to Pakistan, the U.S. branch of the same company denied the sale of similar inverters to a Pakistani buyer. A Pakistani request to a German firm to purchase ten to fifteen tons of uranium yellowcake from South Africa was turned down both by Germany and South Africa. The Dutch government launched an investigation into Khan's employment with FDO and the selling practices of Dutch companies to Pakistani buyers. They recommended strengthening security in nuclear industry, re-fashioning export controls, and launching a criminal prosecution against Khan. The British, once roused, launched an extensive investigation, and reported their findings to the other URENCO partners (France and the Netherlands) and to the London Group of

⁶⁸ Weissman and Krosney, *The Islamic Bomb*, 199-206. Khan confirmed the inverter story. A. Q. Khan, "Uranium Enrichment at Kahuta, A Decade of Experience," *Dawn*, August 1, 1986, reprinted in Malik, *Dr. A. Q. Khan and the Islamic Bomb*, 96.

⁶⁹ Khan, "Uranium Enrichment at Kahuta," in Malik, *Dr. A. Q. Khan and the Islamic Bomb*, 96.

⁷⁰ Weissman and Krosney, *The Islamic Bomb*, 206.

nuclear supplying countries. The United States re-examined its own export controls and also put pressure on other Western countries, as well as applying mild pressure directly on Pakistan.⁷¹

The supplier cartels were battling horizontally and vertically. Bilaterally and through multilateral organizations, states slowly harmonized export controls to prevent Pakistan and others from seeking and exploiting the weakest national regulations. Simultaneously, state regulators had to seek to control further and further down on the chain of production. Initially, Pakistanis were buying entire systems (as in the massive Swiss gasification and solidification unit), then they were buying sub-systems, then major components, then materials useful in engineering the components themselves. As the U.S. journalists Steve Weissman and Herbert Krosney note, “The clever Pakistanis were staying a step ahead of the game by buying the individual parts and assembling more and more of the equipment themselves in Pakistan itself.”⁷²

Khan’s procurement network was paying important dividends. To create the internal infrastructure—the roaring cascades of centrifuges gradually enriching the uranium gas—this external procurement network was critical. In the early years, Pakistan’s desire for a nuclear weapon as soon as possible was tearing Khan’s cascade of whirling centrifuges apart. Shortcuts, limited diagnostics, and an emphasis on speed over precision meant that centrifuges were breaking down. Within five years, according to one Western intelligence official, their first cascades had been devastated from the loss of machines. Pakistan would have to expend significant resources just to replace the lost

⁷¹ Weissman and Krosney, *The Islamic Bomb*, 205-212.

⁷² Ibid., 207; also Khan, “Uranium Enrichment at Kahuta,” in Malik, *Dr. A. Q. Khan and the Islamic Bomb*, 96.

capacity.⁷³ But the cost had been worth it. By the mid-1980s, within a decade of Khan leaving his URENCO offices for the last time, Pakistan had produced enough highly enriched uranium for a weapon.⁷⁴

C. IF YOU PLAY IN THE MUD

In many ways, the story of A. Q. Khan is reminiscent of an “Indiana Jones” movie. Our protagonist is racing down a long corridor, with nonproliferation barriers rising in front of him, and he has to quickly navigate these obstacles lest he be crushed. After Khan overcomes each hurdle, a new one emerges in front of him that he must circumvent to avoid failure. In a very real sense, Khan was in a race against the most powerful governments around the world. While their resources are massive, their bureaucracies were slow to respond to new proliferation practices and had an even more difficult time cooperating with one another to stem the rising tide of illicit nuclear exports. Khan stayed one step ahead of the competition for almost three decades.

To succeed, Khan had to deal with nefarious characters all around the world. He gained access to enormous amounts of poorly accounted for money, and gained control over contracts worth millions that would not be audited. Weary that the bureaucratic lethargy of PAEC would be replicated, the Pakistani state had given Khan broad autonomy to run his research laboratories. This meant less oversight, and greater potential for corruption. This was a very slippery slope on which Khan traversed. Graham Allison, a former Clinton administration defense official, has commented, “You don’t find people of integrity who operate in that zone.”⁷⁵

In defending KRL, Gen. Aslam Beg inadvertently indicates how an atmosphere of impropriety can slowly develop:

If a scientist is given 10 million dollars to get the equipment how would he do it? He will not carry the money in his bag. He will put the money in a

⁷³ Mark Hibbs, “CIA Assessment on DPRK Presumes Massive Outside Help on Centrifuges,” *Nuclear Fuel*, November 25, 2002. Owen Bennett Jones notes that periodic earthquakes in Pakistan did not help matters. Centrifuges rotate at such high speeds that they must remain carefully balanced. Earthquakes have the potential to disrupt catastrophically the operation of a centrifuge cascade. Jones, *Pakistan: Eye of the Storm* (New Haven, Conn.: Yale University Press, 2002), 201. Also see Mark Hibbs, “Pakistan’s quest for UF₆ sensors underlines limits of NSG controls,” *Nuclear Fuel*, March 28, 2005.

⁷⁴ Jones quotes Khan as saying that he had sufficient highly enriched uranium by 1982, only six years after he returned to Pakistan. Jones, *Pakistan*, 201.

⁷⁵ Quoted in Douglas Frantz, “From Patriot to Proliferator,” *Los Angeles Times*, September 23, 2005.

foreign bank account in someone's name. The money lies in the account for some time, and the mark-up that fetches may probably have gone into his account. It is a fringe benefit. It is very logical that somebody contacts a scientist telling him that ARY Gold determines gold [prices] in the region, so why not invest a million dollars or have it invested on his behalf? This may have happened. Is it a crime? No.⁷⁶

In this sort of environment, no one raised serious objections when Khan's former son-in-law and Khan's uncle received profitable contracts to procure materials significantly over market rates.⁷⁷ Or, if objections were raised, Pakistan's national security managers were quick to silence them, lest Khan's "legitimate" work be put into jeopardy.

D. AN UNHEALTHY RIVALRY

Abdul Qadeer Khan is often referred to as the father of the Pakistani nuclear weapons program.⁷⁸ But he is not. A more accurate, but less grandiose, description would be that Khan is the father of the Pakistani uranium enrichment program. In this role, Khan had a crucial but circumscribed mission: to generate sufficient quantities of fissile material for a Pakistani nuclear weapons arsenal. Khan was part of a broader Pakistani nuclear weapons effort, where most requirements were tasked to a rival organization: the Pakistan Atomic Energy Commission (see Figure 1, next page).

Khan continually sought to expand the responsibilities entrusted to his laboratories. As his nuclear transactions demonstrate, Khan apparently gained expertise in fields other than uranium enrichment. He may have achieved competency in designing the bomb, developing a trigger mechanism, converting uranium gas into a metal, and perhaps work on design assembly itself.⁷⁹ This expanded workload may have received some sanction by the Pakistani state, it may have been developed independently at Khan's own initiative, or it likely was some combination of both. In any event, by the

⁷⁶ Quoted in Douglas Frantz, "From Patriot to Proliferator," *Los Angeles Times*, September 23, 2005

⁷⁷ Kamran Khan, "Business in Timbuktu: Conflict Views about Army's Awareness of Qadeer's Engagements," *The News* (Islamabad), February 1, 2004; also Kamran Khan, "Foreign Accounts Having Proceeds from N-Technology Transfer Found," *The News* (Islamabad), January 25, 2004.

⁷⁸ For instance, thirty-five New York Times stories have used some variation on the phrase "father of Pakistan's atomic bomb."

⁷⁹ See Shahid-ur-Rehman, *Long Road to Chagai* (Islamabad: Print Wise, 1999), 6, 67, and 94.

late 1980s, Khan had knowledge of nuclear activity beyond just uranium enrichment and was able to transfer some of that knowledge and technology to other states.

The rivalry manifested itself in two visible ways: a public relations battle to win popular esteem (and discredit the opposing laboratory) and a competition over responsibilities and resources between the two organizations. The public rivalry was particularly vicious, with both parties spreading allegations about the patriotism, competence, and integrity of the other. Munir Ahmad Khan did less to harness journalists to attack Khan, though PAEC officials did leak concerns about corruption and malfeasance at KRL to favored members of the media.⁸⁰ Both PAEC and KRL officials cooperated with media accounts to ensure their achievements would receive favorable coverage. They authored long op-eds describing their achievements in the English-language newspapers.

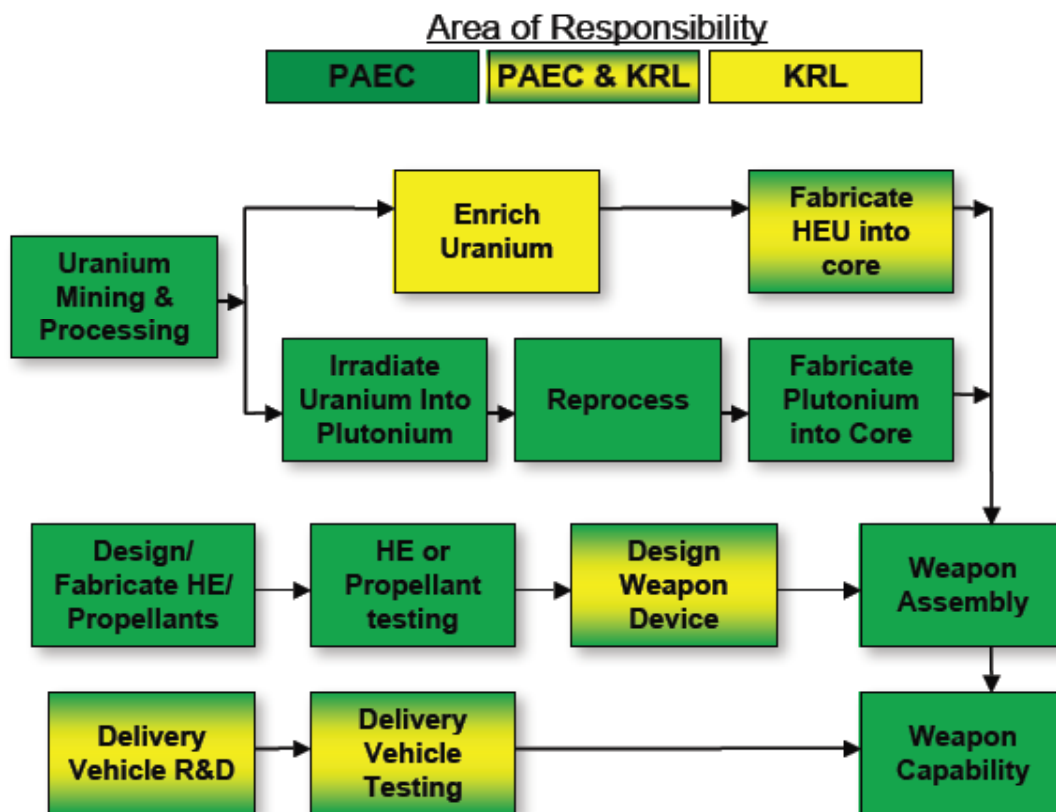


Figure 1. PAEC and KRL Areas of Responsibility

⁸⁰ See the many quotes by “retired nuclear scientists” in Khan, “Business in Timbuktu,” *The News*. The author distinguishes between retired nuclear scientists and retired KRL scientists and officials, implying the former is a phrase for PAEC personnel.

A. Q. Khan patronized perhaps 20 journalists throughout Pakistan, and had a particularly close relationship with his “biographer” Zahid Malik.⁸¹ This was part of a broader effort by A. Q. Khan to give noticeably to charities and educational institutions, perhaps over Rs. 2 billion in total.⁸² A. Q. Khan at the minimum condoned a smear campaign by journalists, like Malik, to discredit Munir and his work. In Malik’s book, there is a chapter entitled, “The Myth of Munir’s Atom Bomb.”⁸³ Elsewhere in the book, Malik claims to quote Zulfikar Ali Bhutto calling Munir “a bastard, a traitor, and a cheat.”⁸⁴ Malik also “reports” that Zia-ul-Haq was of a similar opinion about Munir: “He is a bastard, a CIA agent.”⁸⁵ For his trouble, Malik alleges that Munir reported his hagiographic effort to the security services, which proceeded to seize the journalist’s draft manuscript.⁸⁶

This public battle was an extension of a fierce bureaucratic rivalry occurring behind the scenes. The uranium enrichment effort was initially placed within the Pakistan Atomic Energy Commission hierarchy. As A. Q. Khan achieved successes in his effort to create a gas centrifuge cascade, he asked and received increasing autonomy, culminating in the re-naming of Engineering Research Laboratories after Khan in 1981.⁸⁷ Even after gaining autonomy as head of Khan Research Laboratories, Khan chafed at having to be dependent on PAEC. He blamed Munir Ahmad Khan, PAEC’s director, for shortages and quality control issues with the uranium hexafluoride gas.⁸⁸ A. Q. Khan claimed that PAEC also was lagging behind in its development of the nuclear weapon design itself.⁸⁹

⁸¹ Douglas Frantz, “From Patriot to Proliferator,” *Los Angeles Times*, September 23, 2005.

⁸² Khan, “Business in Timbuktu.” Since the dates of giving are not noted, this amount would vary depending on the exchange rate at the time of each transaction. At February 1, 2004 rates (when the article was written), the figure would amount to a hefty \$36 million. In fact, the figure could be far higher since this total includes only three of Khan’s largest donations to the Ghulam Ishaq Khan Institute of Technology, the Mianwali Institute of Technology, and the Institute for Behavioral Sciences.

⁸³ Zahid Malik, *Dr. A. Q. Khan and the Islamic Bomb* (Islamabad: Hurmat, 1992), 100-120.

⁸⁴ *Ibid.*, 121.

⁸⁵ *Ibid.*, 9.

⁸⁶ *Ibid.*, 5.

⁸⁷ Rehman, *Long Road to Chagai*, 102-3.

⁸⁸ Rehman, *Long Road to Chagai*, 72-4.

⁸⁹ *Ibid.*, 103.

As a consequence, according to Pakistani reporter Shahid-ur-Rehman, Khan claimed that Zia gave KRL sweeping new responsibilities. Rehman is the author of one of the only book-length examinations of the Pakistani nuclear weapons program, though one that suffers from a sensational and hastily crafted style. On this issue, Rehman's text is packed with allegations, so it is best to quote from it at length:

According to Dr A Q Khan, sometimes in 1982, President Zia invited him to the Presidency and directed in the presence of Lt. General A. Zamin Naqvi, Advisor to the President on Nuclear Affairs to start work "all the way," on the manufacture of a nuclear device. This meant that KRL had been commissioned, in addition to uranium enrichment, to design the bomb, develop [the] trigger mechanism, convert enriched uranium into metal, work on the nitty gritty of the device, and assemble it.

Dr Khan claimed that he was instructed by President Zia not to mention his new responsibilities to any body, "not even to Finance Minister Ghulam Ishaq Khan, Foreign Minister Sahibzada Yakub Khan, and his Chief of Staff Lt. General K. M. Arif". As regards funds, he was asked to make use of his own budget or write directly General Zia.

PAEC scientists questioned the veracity of Dr Khan's claim. However, it explained a host of unanswered questions relating to Pakistan's nuclear program, e.g. [the] PAEC complain that Lt. General Zamin Naqvi passed on PAEC design of the device to KRL and [a] similar complaint by KRL against LT General K M Arif.⁹⁰

If Rehman's account is accurate—or, at a minimum, reports Khan's statement accurately—it highlights several of the themes of this study: the Pakistan nuclear weapons program was characterized by an *ad hoc* division of labor, limited governmental oversight, very personalized decision-making, and intense bureaucratic rivalries. The fact that PAEC and KRL scientists were complaining about leaks of senior military officials to opposing laboratories is indicative of a command and control system in disarray.

Did Zia really ask Khan not to reveal information to Ghulam Ishaq Khan, Sahibzada Yakub Khan, and Lt. Gen. K. M. Arif? If so, this is particularly significant because all three were senior members of a committee charged with planning and

⁹⁰ Ibid., Rehman, *Long Road to Chagai*, 6.

oversight of the strategic organizations.⁹¹ Zia would be subverting the one nuclear oversight body that existed. Perhaps, Zia was concerned about American intelligence. Strict compartmentalization might deny the United States information about the existence of Khan's parallel effort. One imagines that there were hundreds of instances in the history of the Pakistani nuclear program where the competing goals of secrecy and oversight were in conflict. It also seems likely that secrecy won more often than oversight. Another possibility is that Khan did not receive instructions from Zia, but claimed a secret instruction to justify unsanctioned expansion into new areas of research and development. That possibility is not comforting either. The only comforting thought is that Rehman made up the entire story or misrepresented it, but the number of details (particularly of crucial names) gives the story a ring of authenticity.

Elsewhere in Rehman's book, he states, "For reasons of security and some other considerations, enriched uranium is now converted into metal by KRL itself."⁹² Later in the volume, Rehman describes KRL's competency in slightly more expansive terms than just re-conversion into metal: "[At Kahuta], uranium gas is enriched to weapon grade level and at a nearby facility converted into metallic cores for uranium devices."⁹³ Rehman implies that KRL had gained skills in casting and fabricating cores, as well.

Rehman's account is substantiated by information from Iran and Libya that indicate that Khan did offer assistance with re-conversion and casting of uranium metal and with creating a nuclear weapons device. At the minimum, we know that Khan had access to extensive nuclear design blueprints and instructions, which were transferred to Libya and perhaps others. As is discussed in chapter four, the situation has been confused somewhat by recent statements by President Pervez Musharraf arguing that

⁹¹ Several senior retired Pakistani civilian and military officials have confirmed the committee's existence and function, including previous members of the committee. Interviews by the author, Islamabad and Rawalpindi, Pakistan, June 2005.

⁹² Rehman, *Long Road to Chagai*, 67.

⁹³ Ibid., 94.

Khan's expertise was restricted to centrifuge enrichment, something that does not appear born out by open Pakistani sources or information gathered on the Iranian or Libyan programs.⁹⁴

E. CONCLUSION

Khan was able to keep ahead of the global export control regime from the mid-1970s to the mid-1980s. His success in nuclear procurement had earned him fame and commendation at home. By the mid-1980s, he had created a network of middlemen, financiers, importers, and front companies that would supply his nuclear enterprise. Khan's genius—and his danger—was to turn this organization from importing into exporting. The next three chapters explore Khan's two decades of nuclear moonlighting through case studies of his assistance to Iran, North Korea, and Libya.

⁹⁴ Shahid-ur-Rehman and Aroosa Alam, "More on Musharraf Says Khan Offered Centrifuges, Designs To N. Korea," *Kyodo World Service* (Tokyo), August 24, 2005, *FBIS report no. JPP20050824000095*.

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III. THE FIRST TIME IS SPECIAL: KHAN'S ASSISTANCE TO IRAN

A. INTRODUCTION

From 1987 to 1999, the Islamic Republic of Iran received nuclear assistance from Dr. Abdul Qadeer Khan, head of Pakistan's Khan Research Laboratories. This assistance included designs, components, technical consulting, and uranium shipments. These transfers significantly aided Iran in its efforts to enrich uranium. If Iran is able to acquire sufficient quantities of fissile material, it will have overcome the most difficult challenge in constructing a nuclear explosive device.

The nuclear assistance from Khan to Iran is remarkable because it dramatically complicated Pakistan's threat environment. Pakistan-Iran relations have been periodically turbulent, and growing Indo-Iranian entente is disconcerting to Islamabad. A nuclear Iran is not a comforting thought to Pakistani leaders in Islamabad or Rawalpindi, who are preoccupied already with threats on their eastern (India) and northern (Afghanistan) borders. Out of all of Khan's nuclear transfers, this challenges the nuclear optimists most directly. Kenneth N. Waltz's argument about good nuclear stewardship is premised on a realist faith in the rationality of a state not to diminish its security. Much of Waltz's analysis is based on an understandable assumption that "[s]tates are not likely to run major risks for minor gains."⁹⁵ However, Khan's assistance to Tehran provided few if any benefits to Pakistan's security, while risking a nuclear neighbor on Islamabad's doorstep—not to mention international opprobrium from close friends (Saudi Arabia) and allies (the United States).⁹⁶

This chapter places Khan's nuclear assistance to Iran in the context of loose safety and security arrangements within the Pakistani nuclear weapons program. As discussed

⁹⁵ Kenneth N. Waltz, "More May Be Better," in *The Spread of Nuclear Weapons: A Debate Renewed* (New York: W.W. Norton, 2003), 6.

⁹⁶ This is not the first time that a nuclear state has assisted a neighbor, nor is it the first time that such assistance resulted in a deteriorated security environment for the supplier. The Soviet Union provided "almost everything" necessary for a nuclear weapons program to the Peoples' Republic of China in a burst of nuclear collaboration from 1957 to 1960. The technology transfer was ultimately halted as the Soviet leadership became convinced of the unreliability of the Chinese as a partner, but not before greatly assisting Beijing's nuclear program. See John Wilson Lewis and Xue Litai, *China Builds the Bomb* (Stanford, Calif.: Stanford University Press, 1988), 60-72.

in the previous chapter, the failure of the Pakistan Atomic Energy Commission in the 1970s to secure a plutonium reprocessing plant had been partially blamed on bureaucratic red tape and fiscal straight jackets. Khan Research Laboratories was granted autonomy and flexibility, and delivered results that seemingly validated this bureaucratic freedom. This autonomy necessarily meant that oversight was diminished, providing Khan with the space to conduct his nuclear entrepreneurship. This chapter also provides evidence that a unique constellation of Pakistani policymakers in the late 1980s may have been predisposed to permit Khan to provide limited nuclear assistance to Iran. It argues, however, that Khan likely exceeded any policy opening provided by Pakistani authorities. It concludes by assessing how significant Pakistani assistance has been in a larger potential effort by Iran to acquire nuclear weapons.

This chapter demonstrates that Khan's assistance advanced the Iranian nuclear program. This provision of nuclear technology to a potential adversary should cause nuclear optimists considerable discomfort. Their faith is based on a belief that nuclear secrets will be held tight and states will do so because of concerns about their own security. The assistance to Iran is evidence that Pakistan was either unable or unwilling to prevent such transfers. In either event, the optimists should worry.

B. A NUCLEAR OFFER

As discussed in the previous chapter, Khan had spent the decade since he left the Netherlands constructing an impressive nuclear organization for Pakistan. He developed a system to identify, pay for, procure, and ship nuclear-related components, technologies, and materials from Europe to Pakistan. These foreign-acquired items were then integrated into an increasingly sophisticated indigenous nuclear infrastructure, supported by a growing cadre of nuclear scientists. Sometime in the mid-to-late 1980s, Khan appears to have diverted the flow. He was still bringing in material and components for his nuclear enrichment process, but he seems to have been ordering more than Pakistan needed.⁹⁷ At the same time, Khan Research Laboratories was maturing. KRL scientists published papers starting in 1987 on constructing more difficult centrifuges of maraging steel, rather than the earlier aluminum-based designs. In 1991, KRL scientists published

⁹⁷ William J. Broad, David E. Sanger, and Raymond Bonner, "A Tale of Nuclear Proliferation," *New York Times*, February 12, 2004.

details of how to etch special grooves into the bottom bearing of the centrifuge to incorporate lubricants.⁹⁸ Both trends—over-ordering and technological innovation—left Khan with excess inventory. An anonymous American official marveled at the accomplishment: “First, he exploits a fragmented market and develops a quite advanced nuclear arsenal. Then he throws the switch, reverses the flow and figures out how to sell the whole kit, right down to the bomb designs, to some of the world’s worst governments.”⁹⁹

The first country that Khan sold to was Iran. Reportedly, in 1987, three Iranian officials met several members of Khan’s network in Dubai, perhaps including an uncle-nephew team of Sri Lankan businessmen, Mohamed Farouq and Buhary Syed Ali Tahir, and a German engineer named Heinz Mebus.¹⁰⁰ Tahir would gain international notoriety in 2003 when President George W. Bush called him the Khan network’s chief financial officer—though in 1987 he would have been fairly young.¹⁰¹ An Iranian exile group has claimed that one of the Iranian representatives was then-Brig. Gen. Mohammad Eslami, at the time in charge of the Iranian Revolutionary Guard’s research center. If Eslami was present, it would indicate that even at this early stage the cooperation was viewed as having military utility.¹⁰² Khan’s intermediaries apparently presented a one-page

⁹⁸ “From Rogue Nuclear Programs, Web of Trails Leads to Pakistan,” *New York Times*, January 4, 2004.

⁹⁹ Quoted in Broad, Sanger, and Bonner, “A Tale of Nuclear Proliferation.”

¹⁰⁰ There is clearly a great deal of uncertainty over the meeting, with reporters using equivocating adverbs before descriptions of locations, dates, and names. Most accounts name Farouq, but some are more equivocal on Tahir and/or Mebus’s presence. See Stephen Findler, “Fresh Clues on Smuggling Network Could Lift Lid on Tehran’s Secret Nuclear Program,” *Financial Times*, March 12, 2005; Dafna Linzer, “Iran Was Offered Nuclear Parts,” *Washington Post*, February 27, 2005. The IAEA has confirmed the outlines of the story: Pierre Goldschmidt, IAEA Deputy Director General, “Statement to the Board of Governors,” March 1, 2005, <http://www.iaea.org/NewsCenter/Statements/DDGs/2005/goldschmidt01032005.html> (accessed March 7, 2005). For some reason, the Goldschmidt statement is no longer available on the IAEA website, though excerpts are available at <http://www.iranwatch.org/international/IAEA/iaea-goldschmidt-statement-030105.htm> (accessed April 5, 2005). Mohamed Farouq should not be confused for Muhammad Farooq, a centrifuge expert at KRL, who was involved extensively with Khan’s nuclear smuggling. Kamran Khan, “Dr. Qadeer’s Future Still Uncertain,” *The News* (Islamabad), January 31, 2004.

¹⁰¹ “President Announces New Measures to Counter the Threat of WMD,” Remarks by the President to the National Defense University, Washington, D.C., February 11, 2004, <http://www.whitehouse.gov/news/releases/2004/02/20040211-4.html>.

¹⁰² “Iranian Dissident Fires Ukraine, Iran Charges on Tehran’s Nuclear Program,” *Agence France Presse*, August 26, 2005.

handwritten note outlining a five-point, phased nuclear weapons development plan. Though this was Khan's first offer, he apparently hit the ground running. According to the IAEA,

This document suggests that the offer included the delivery of: a disassembled sample machine (including drawings, descriptions, and specifications for production); drawings, specifications and calculations for a "complete plant"; and materials for 2000 centrifuge machines. The document also reflects an offer to provide auxiliary vacuum and electric drive equipment and uranium re-conversion and casting capabilities.¹⁰³

Khan apparently also provided Iran with information on circumventing existing export controls. According to one anonymous Pakistani source, "We confided in them about the items needed to construct a nuclear bomb, as well as the makes of equipment, the names of companies, the countries from which they could be procured and how they could be procured."¹⁰⁴ The Iranians may have outsmarted Khan, however. Using Khan's document as a shopping list, IAEA employees reportedly believe that Iran instead went to European, Russian, and Chinese firms to purchase the equipment and technology at lower prices.¹⁰⁵ Iran's ability to continue to purchase from Western companies is a key indicator that efforts to improve export controls were only partially successful.¹⁰⁶

Even if the Iranians did not purchase Khan's "package deal," they apparently did buy centrifuges, designs, and centrifuge technology. Cooperation began in 1987,¹⁰⁷

¹⁰³ Goldschmidt, "Statement to the Board of Governors," March 1, 2005.

¹⁰⁴ Ansari, "Nuclear Scientists from Pakistan Admit Helping Iran with Bomb-Making."

¹⁰⁵ Linzer, "Iran Was Offered Nuclear Parts." This "shopping list" has been discussed by Pakistani and IAEA sources in media reports. However, it should be noted that Iran says it has no accompanying documentation of this meeting besides the one handwritten note. See International Atomic Energy Agency, "Implementation of the NPT Safeguards Agreement in the Islamic Republic of Iran," report by the Director General to the Board of Governors, GOV/2005/67, September 2, 2005, 13; the leaked report is available at http://www.armscontrolwonk.com/GOV_2005_67.pdf

¹⁰⁶ Jack Boureston has said that Iran was able to receive "high-strength aluminium, maraging steel, electron beam welders, balancing machines, vacuum pumps, computer-numerically controlled machine tools, and flow-forming machines for both aluminium and maraging steel" from Europe, as well as training for the use of the equipment. Boureston, "Fuel Cycle: Tracking the Technology," *Nuclear Engineering International*, September 30, 2004.

¹⁰⁷ See footnote 28 and International Atomic Energy Agency, "Implementation of the NPT Safeguards Agreement in the Islamic Republic of Iran," Report by the Director General to the Board of Governors, GOV/2004/83, November 29, 2004, 6.

though Khan reportedly visited the Bushehr nuclear facility in February 1986.¹⁰⁸ At that time, in addition to inadvertently providing a shopping list, Khan apparently provided Iran with designs for the P-1 aluminum rotor centrifuge and sample components for that centrifuge.¹⁰⁹ Between 1994 and 1996, Iran received an apparently duplicate set of P-1 designs along with components for 500 centrifuges.¹¹⁰ It seems that these components were from models that Pakistan had used previously to enrich uranium, perhaps explaining most—if not all—of the enriched uranium contamination found on Iran equipment.¹¹¹ Iran claimed that it had difficulty setting up the centrifuge cascades, and blamed this difficulty on “poor quality components.”¹¹² At least once, in 1997, Khan’s network replaced previously supplied bellows because of their inferior performance.¹¹³ Also between 1994 and 1996, Iran received designs for the more advanced P-2 centrifuge, though Iran claims it did not work on this design until early 2002.¹¹⁴ Though the Pakistani P-2 uses maraging steel for the spinning rotors that separate different densities of uranium, Iran claims it had difficulty manufacturing those components. Instead, Iran attempted to use a “shorter, sub-critical carbon composite rotor.”¹¹⁵

¹⁰⁸ Kenneth R. Timmerman, “Weapons of Mass Destruction: The Cases of Iran, Syria, and Libya,” A Simon Wiesenthal Center Special Report from *Middle East Defense News* (August 1992): 42, cited in Nuclear Threat Initiative, “Iran Nuclear Chronology 1987,” http://www.nti.org/e_research/e1_iran_nch_1987.html (accessed April 5, 2005).

¹⁰⁹ “Implementation of the NPT Safeguards Agreement in the Islamic Republic of Iran,” November 29, 2004, 6.

¹¹⁰ Ibid.; also see “Press Release by Inspector-General of Police in Relation to Investigation of Alleged Production of Components for Libya’s Uranium Enrichment Programme,” February 20, 2004, http://www.rmp.gov.my/rmp03/040220scomi_eng.htm.

¹¹¹ David Albright and Corey Hinderstein, “Unraveling the A. Q. Khan and Future Proliferation Networks,” *Washington Quarterly* 28, no. 2 (Spring 2005): 115; also on contamination see “Implementation of the NPT Safeguards Agreement in the Islamic Republic of Iran,” November 29, 2004, 9-10, 23.

¹¹² International Atomic Energy Agency, “Implementation of the NPT Safeguards Agreement in the Islamic Republic of Iran,” Report by the Director General to the Board of Governors, November 10, 2003, GOV/2003/75, 8.

¹¹³ “Implementation of the NPT Safeguards Agreement in the Islamic Republic of Iran,” November 29, 2004, 8.

¹¹⁴ Ibid., 10-11; also see John Bolton, Undersecretary of State for Arms Control and International Security, “Statement to the House Committee on International Relations Subcommittee on the Middle East and Central Asia on Iranian Proliferation,” June 24, 2004. Early in his testimony Bolton says that Iran procured P-2 components, but subsequently in a longer discussion of the P-2, he seems to only suggest that Iran was procuring materials for the P-2.

¹¹⁵ “Implementation of the NPT Safeguards Agreement in the Islamic Republic of Iran,” November 29, 2004, 10-11. Sub-critical rotors operate below their first natural frequency of resonance. Super-critical rotors operate above that frequency.

Anonymous IAEA officials have been quoted in the press saying they also suspect that Iran received a nuclear weapons design from the Khan network.¹¹⁶

C. A UNIQUE CONSTELLATION OF PERSONALITIES

Why would A. Q. Khan sell nuclear technology to the western neighbor of Pakistan? The Iranian case appears to be an odd and ambiguous confluence of a misguided sense of national interest, an ideological opposition to the Western export control regime, and the personal greed of A. Q. Khan and his cronies. First, Khan may have received permission from Pakistan's national leadership to begin nuclear cooperation with Iran. Once the door for limited nuclear collaboration was open, even a crack, Khan may have used such policy approval to barge through it.

Pakistani journalist Kamran Khan has quoted retired Pakistani scientists saying that President and Army chief Zia ul-Haq had opened the door to both peaceful and "non-peaceful" nuclear cooperation before his death in 1988. One anonymous scientist described Zia's intent as "to play around but not to yield anything substantial at any cost."¹¹⁷ This seems somewhat dubious given Zia's pro-Sunni, anti-Shi'a credentials, and the general souring of Pakistani-Iranian relations after the Iranian Revolution.

Khan's opening to Iran does seem to coincide with the elevation of Mirza Aslam Beg to the position of Vice Chief of Army Staff in March of 1987 and his subsequent tenure as Army chief from 1988 to 1991. Beg held peculiar views of a Pakistani-Afghan-Iranian (and possibly Turkish) alliance that could act in "strategic defiance" of the West. Strategic defiance was never a very clear notion, but it seemed to involve "strengthening collective defenses of regional Muslim countries" through joint training, defense production, and perhaps formal agreements. In particular, Beg seemed to hold particular regard for Iranian thinking on matters of international security.¹¹⁸

¹¹⁶ Tim Reid, "Blueprints 'Prove Iran Is Pursuing Nuclear Weapons,'" *The Times* (London), February 13, 2004.

¹¹⁷ Khan, "Dr Qadeer's Fate Hangs in the Balance." *The News* (Islamabad), January 24, 2004.

¹¹⁸ Quotation is from an editorial in *The Muslim* (Pakistan), December 4, 1990, quoted in Brian Cloughley, *A History of the Pakistan Army: Wars and Insurrections* (New York: Oxford University Press, 1999), 310. For more on strategic defiance, see Cloughley, *A History of the Pakistan Army*, 309-313; and Dennis Kux, *The United States and Pakistan, 1947-2000: Disenchanted Allies* (Washington, D.C.: Woodrow Wilson Center Press, 2001), 312-313.

There are more reasons than just old security views to implicate Beg. Former U.S. Assistant Secretary of Defense for International Security Affairs, Henry Rowen, has claimed that in January 1990 Beg presented Rowen with a very clear threat: “if Pakistan was cut off [from U.S. military assistance] it might be forced to share nuclear technology with Iran.”¹¹⁹ According to Rowen’s recounting, Beg’s threat did not explicitly mention weapons technology, but focused on nuclear technology more generally.

Robert Oakley, the U.S. Ambassador to Pakistan at the time of Beg’s tenure, also has implicated Beg. Steve Coll referenced a 2002 interview with Oakley as the source behind Coll’s claim that Beg

opened discussions in Tehran with the Iranian Revolutionary Guard about the possibility of Pakistani nuclear cooperation with Iran. Beg discussed a deal in which Pakistan would trade its bombmaking expertise for Iranian oil. Oakley met with the Pakistani general to explain ‘what a disaster this would be, certainly in terms of the relationship with the United States,’ and Beg agreed to abandon the Iranian talks.¹²⁰

An unnamed “Pakistani investigator” has claimed that Beg was “in the picture” regarding Khan’s assistance to Iran, though he most likely did not know how extensive such cooperation was. Pakistani investigators reportedly have found evidence that Khan informed Beg of the transfer of outdated equipment to Iran in 1991.¹²¹

More recently, Beg wrote an op-ed in one of Pakistan’s leading English newspapers floating the bizarre notion that Pakistan and India should jointly provide nuclear weapons to Iran under some sort of custodial arrangement similar to that used within the North Atlantic Treaty Organization.¹²² Beg has denied any wrongdoing, but his

¹¹⁹ Farhan Bokhari, et al, “Pakistan’s ‘Rogue Nuclear Scientist’: What Did Khan’s Government Know about His Deals?” *Financial Times*, April 6, 2004; also Matt Kelley, “Pakistan Threatened to Give Nukes to Iran,” *Associate Press*, February 27, 2004. Beg called Rowen’s claim a “blatant lie.” “Beg Denies Involvement in N-Tech Transfer,” *Dawn* (Karachi), February 29, 2004.

¹²⁰ Steve Coll, *Ghost Wars* (New York: Penguin, 2004), 221.

¹²¹ John Lancaster and Kamran Khan, “Musharraf Named in Nuclear Probe,” *Washington Post*, February 3, 2004.

¹²² Mirza Aslam Beg, “South Asian Nuclear Security Regime,” *Dawn* (Karachi), March 7, 2005 and Mirza Aslam Beg, “Outside View: Nuke Proliferators Can’t Be Stopped,” *United Press International*, March 7, 2005.

denials have focused more on the lack of evidence against him than in denying support for such a policy. In fact, he pointedly refused to say that what occurred was illegal.¹²³

Other Pakistani press accounts have noted the important role of Ghulam Ishaq Khan, chairman of Pakistan's Senate from 1985 to 1988 and president from 1988 to 1993. As one anonymous Pakistani official put it, "If A. Q. Khan is the father of Pakistan's nuclear bomb, Ghulam Ishaq Khan was the grandfather."¹²⁴ Ghulam Ishaq Khan worked closely with A. Q. Khan in the 1970s, 1980s, and early 1990s.¹²⁵ For instance, as finance minister in 1981, Ghulam Ishaq Khan gave tax-free status to the BCCI Foundation, the non-profit branch of a particularly complex and corrupt financial empire. In the late 1980s, BCCI returned the favor by funneling \$10 million dollars worth of grants into the Ghulam Ishaq Khan Institute of Engineering Sciences and Technology, which at that time was directed by A. Q. Khan and widely considered to be a front for Khan Research Laboratories.¹²⁶

Finally, at least one press account places blame on the now deceased Maj. Gen. Imtiaz Ali for pressuring Khan into supplying enrichment equipment and designs to Iran.¹²⁷ Imtiaz, who is referred to by his first name, was military secretary to Zulfikar Ali Bhutto's government when A. Q. Khan returned to Pakistan and had a key role in liaising with Khan as he set up Pakistan's enrichment facility.¹²⁸ Later, he was military advisor to Benazir Bhutto during her first term as civilian prime minister from December 1988 to August 1990.

This unique constellation of political personalities—Beg, Ghulam Ishaq Khan, and Imtiaz—all may have been inclined to give Khan permission to proceed with some

¹²³ Zahid Hussain, interview with Mirza Aslam Beg, "There is a Conspiracy Against Me by the Jewish Lobby," *Newsline* (Karachi), March 3, 2004.

¹²⁴ Khan, "Dr Qadeer's Fate Hangs in Balance," January 24, 2004.

¹²⁵ A. Q. Khan describes the many roles played by Ghulam Ishaq Khan in "Interview with Abdul Qadeer Khan," *The News* (Islamabad), May 30, 1998, reproduced at <http://nuclearweaponarchive.org/Pakistan/KhanInterview.html>.

¹²⁶ Senator John Kerry and Senator Hank Brown, *The BCCI Affair*, A Report to the Committee on Foreign Relations, United States Senate (December 1992), http://www.fas.org/irp/congress/1992_rpt/bcci/05foreign.htm.

¹²⁷ "Re-imposition of sanctions feared: US aid may be jeopardized – official," *Dawn* (Karachi), February 5, 2004, <http://www.dawn.com/2004/02/05/top5.htm>.

¹²⁸ See Niazi, "Unknown Facts about the Reprocessing Plant," in *Pakistan's Bomb*, 358-362.

sort of cooperation with Iran. While there is no definitive evidence, it seems plausible that Zia, perhaps at Beg's behest, allowed for very limited, non-substantive nuclear cooperation with Iran in 1987 or 1988. It also seems likely that Beg permitted or ordered expanded cooperation with Iran, as part of a broader policy of strategic defiance. Perhaps Ghulam Ishaq Khan or Maj. Gen. Imtiaz, having worked intimately with Khan for over a decade, did not oppose such cooperation if they even learned about it. And there is at least one press report that Imtiaz actually encouraged such cooperation.

D. MOTIVATIONS FOR NUCLEAR COOPERATION

A number of things do not make sense about the cooperation with Iran. First, why was Khan's opening bid so large—essentially offering the Iranians a “turnkey” nuclear program? It seems unlikely, though not impossible, that even this group of policymakers would want a fourth nuclear-armed neighbor on Pakistan's border.¹²⁹ If the scale of the cooperation was not approved by top officials, then Khan's nuclear moonlighting began almost the moment he had an opportunity to sell. This may explain the second incongruity with the Pakistan-Iran cooperation: its more than a decade-long persistence. Iran admits to meeting thirteen times with “the clandestine supply network” between 1994 and 1999.¹³⁰ Strategic defiance was never a national policy, more of a fuzzy idea being hawked by Beg and his close associates. After Beg, Ghulam Ishaq Khan, and Imtiaz left the scene, one would have expected the cooperation to wither away. Instead, starting in 1994, it was reinvigorated, with another set of P-1 designs and components as well as designs for the P-2. This expanded relationship occurred precisely as the Pakistani-Iranian relationship was growing more troubled over the conduct of the Afghan civil war.¹³¹ The persistence of cooperation in spite of changes in Pakistani leadership and the broader Iran-Pakistan relationship may indicate that A. Q. Khan was the primary motivator behind the assistance to Tehran.

The 1990s were a tumultuous time for Pakistan as it experimented with varying levels of democratic rule. Khan, an adroit bureaucratic operator, may have been able to

¹²⁹ At the time, the Soviet Union was in Afghanistan.

¹³⁰ “Implementation of the NPT Safeguards Agreement in the Islamic Republic of Iran,” November 29, 2004, 8.

¹³¹ See Ahmed Rashid, *Taliban: Militant Islam, Oil and Fundamentalism in Central Asia* (New Haven, Conn.: Yale University Press, 2000), 196-206.

use the in-fighting amongst political leaders to create space in which his burgeoning nuclear enterprise could expand and prosper.¹³² It seems that while the initial opening to Iran may have had the approval or acquiescence of a few key policymakers, Khan dramatically went beyond his mandate in his cooperation with Iran.

Khan may have continued his nuclear dealings with Iran for money and, to a lesser extent, ideology. Khan's "money man," B. S. A. Tahir has admitted that he was paid \$3 million worth of United Arab Emirates' *dirhams* for two containers of used centrifuges, and that he then delivered two briefcases full of the money to A. Q. Khan's guest house in Dubai.¹³³ The international investigations of the Khan network reportedly have demonstrated that millions of dollars went from Iran into the bank accounts of Pakistani nuclear scientists and that these nuclear scientists, including Khan, held tens of millions of dollars of undisclosed assets in Pakistan and abroad.¹³⁴ Some of these investigations are reminiscent of Captain Renault's shock that gambling is occurring in Rick's Café in "Casablanca."¹³⁵ After all, Khan's lavish home, regular foreign travel, and extensive charitable giving were well known around Islamabad.¹³⁶ However, Pakistanis say with some credibility that they expected Khan earned his extra income from corruption, and many are still upset that he was not content with skimming from the top of KRL's books and instead supplemented his income with nuclear smuggling that damaged Pakistani security.¹³⁷

Khan also had lesser ideological motivations. He was intensely opposed to the Western export control regime. He sought to pierce the "clouds of so-called secrecy" that

¹³² Peter R. Lavoy and Feroz Hassan Khan, "Rogue or Responsible Nuclear Power? Making Sense of Pakistan's Nuclear Practices," *Strategic Insights* 3, no. 2 (February 2004), <http://www.ccc.nps.navy.mil/si/2004/feb/lavoyFeb04.asp>.

¹³³ "Press Release by Inspector-General of Police in Relation to Investigation of Alleged Production of Components for Libya's Uranium Enrichment Programme," February 20, 2004.

¹³⁴ Khan, "Foreign Accounts Having Proceeds From N-Technology Transfer Found," *The News*.

¹³⁵ Having thought of this analogy, I was disappointed to find it was unoriginal. Animesh Ghoshal, "Shock! And Then the Case Is Closed," *Financial Times*, April 12, 2004.

¹³⁶ Kamran Khan, "Business in Timbuktu: Conflict Views about Army's Awareness of Qadeer's Engagements," *The News* (Islamabad), February 1, 2004.

¹³⁷ Massoud Ansari, "Nuclear Scientists from Pakistan Admit Helping Iran with Bomb-Making," *The Telegraph* (U.K.), January 25, 2004.

such a regime sought to create.¹³⁸ These views appeared to have been amplified as they related to Muslim countries. In a 1995 speech, Khan lamented Western “efforts to curtail the development of the Muslim World which the Western powers unjustifiably see as a potential threat to their monopoly. Development made by certain Muslim states in the restricted technologies does not trickle down to others because of international pressure and lack of coordination and cooperation among the Muslim countries.”¹³⁹ Khan continued by calling for greater collective efforts amongst Muslim countries, and in particular for increased joint defense research and development. Together, Khan’s greed and ideological inclinations may have pushed him to assist other countries, with or without formal approval from policymakers.

E. SIGNIFICANCE OF PAKISTANI ASSISTANCE

Pakistan’s assistance to Iran should not be exaggerated, nor should it be understated. Iran is unlikely to have made as much progress on its centrifuge enrichment program as it has without Khan’s assistance. Three significant bottlenecks remain: (1) sufficient quantities of uranium feedstock; (2) engineering challenges of running a large-scale centrifuge cascade; and (3) the re-conversion and casting from uranium gas to metal and the production of a warhead.¹⁴⁰ Briefly, there are reasons to suspect that each of the bottlenecks will present some difficulties to the Iranians if they are attempting to create a nuclear weapon. In all of these areas, the broader point is the same: Khan’s assistance was largely limited to uranium enrichment. Developing an atomic weapon, however, has a number of other steps, many of which were outside of KRL’s mandate. Significantly, however, if Khan transferred a nuclear warhead design to Iran, as he did to Libya, it may have diminished potential delays Iran might experience in weaponization.

¹³⁸ Broad, Sanger, and Bonner, “A Tale of Nuclear Proliferation,” February 12, 2004.

¹³⁹ A. Q. Khan, “Restricted Areas of Science and Technology and Ways to Develop Such Technologies in the Muslim World,” Speech Delivered at the International Conference on Science in Islamic Polity in the Twenty-First Century from March 26 to 30, 1995 in Islamabad, Pakistan, reprinted in *Dr. A. Q. Khan on Science and Education*, S. Shabbir Hussain and Mujahid Kamran, eds. (Lahore: Sang-e-Meel, 1997), 169-82.

¹⁴⁰ Mark Hibbs, “Iran’s Critics Reject South African Proposal to Let Iran Operate UCF,” *Nuclear Fuels*, September 26, 2005; also see discussion in Jeffrey Lewis, “Give An Inch, Hey Swim All Over You,” *ArmsControlWonk.com*, November 10, 2005, <http://www.armscontrolwonk.com/856/us-eu3-may-let-iran-convert-uranium>.

First, Iran's centrifuges are only useful with sufficient quantities of uranium feedstock. In 1993-1994, the Iranians had contracted with the Chinese to build a facility to convert uranium metal into uranium gas (hereafter a UCF, or Uranium Conversion Facility) at Esfahan. Under intense pressure from the United States, however, the Chinese began negotiations to pull out from the contract in 1996, and finished their negotiated withdrawal from the work in 1998.¹⁴¹ Apparently, the Iranians had obtained "extensive UCF design documentation" from the Chinese prior to their pullout, which Iran claims to have used in creating a quasi-indigenous UCF. The IAEA experts that examined the facility and the documentation have judged Iranian claims to be credible.¹⁴² Nevertheless, Iran may still face challenges in its uranium conversion efforts. A recent *Arms Control Today* report quotes an anonymous State Department official describing suspicions of Iranian difficulties in the conversion, storage, and handling of the highly corrosive uranium hexafluoride gas. In the same report, however, another Western diplomatic source argues that any such difficulties could potentially be overcome in short-term.¹⁴³

A recently leaked IAEA report indicates that Iran has managed to convert 6,800 kg of uranium hexafluoride, which would be enough for perhaps one nuclear explosive device.¹⁴⁴ Quantity is not necessarily quality, however. One anonymous diplomat told Reuters, "The [Iranian] UF₆ is crap." Another was more circumspect, saying, "I wouldn't say it's garbage. But the UF₆ produced at Isfahan is of such poor quality that if it were fed into centrifuges it could damage them."¹⁴⁵

¹⁴¹ "God's Hand Was At Work," Interview with Dr. Mohammad Sa'idi, Atomic Energy Organization of Iran Deputy for Planning and International Affairs with Mehdi Mohammadi, *Keyhan*, April 27, 2005, *FBIS Translated Text*.

¹⁴² International Atomic Energy Agency, "Implementation of the NPT Safeguards Agreement in the Islamic Republic of Iran," Report by the Director General to the Board of Governors, GOV/2004/83, November 29, 2004, 5.

¹⁴³ Paul Kerr, "Iran's Nuclear Activities Limited," *Arms Control Today* (September 2005), http://www.armscontrol.org/act/2005_09/IranLimits.asp.

¹⁴⁴ International Atomic Energy Agency, "Implementation of the NPT Safeguards Agreement in the Islamic Republic of Iran," Report by the Director General to the Board of Governors, GOV/2005/67, September 2, 2005, 13; the leaked report is available at http://www.armscontrolwonk.com/GOV_2005_67.pdf; also George Jahn, "UN Report Says Iran Has Basic Stock for 1 Weapon," *Chicago Tribune*, September 3, 2005.

¹⁴⁵ Francois Murphy and Louis Charbonneau, "Iran's Uranium Gas Unusable for Atomic Fuel-Diplomats," *Reuters*, September 27, 2005.

Second, even if Iran were able to manufacture sufficient quantities of feedstock, it would have to process it through a large cascade of centrifuges running at high speeds and efficiencies. The IAEA has reported that Iran has 1274 assembled rotors at Natanz, though David Albright and Corey Hinderstein have estimated that only about 500 of these are functional.¹⁴⁶ Assuming Iran is able to bring additional rotors online at 70-100 centrifuges per month, Albright and Hinderstein argue that Iran could have a nuclear weapon by early 2007. They admit that this would be the best-case scenario, and indicate that Iran may have difficulty keeping the cascade running. The anonymous State Department official in the *Arms Control Today* report indicates that Iran may be experiencing just such problems.¹⁴⁷ A recent U.S. National Intelligence Estimate reportedly concluded that Iran was at least ten years from having sufficient fissile material for a nuclear weapon, implying that a bottleneck exists in either the uranium conversion or enrichment phases, or possibly both.¹⁴⁸

Third, after Iran acquires sufficient quantities of fissile material, it would have to convert the enriched uranium gas into metal and manufacture the components for a nuclear warhead. Albright and Hinderstein argue that this process might only take a few more months.¹⁴⁹ According to press reports on the most recent U.S. government estimate, there is no consensus within the intelligence community on when Iran would be ready with an implosion device.¹⁵⁰ It is possible that Khan provided Iran with blueprints of a tested implosion design, as he did with the Libyans. If so, that could significantly ease Iran's task. Even if this were the case, it is unclear if such a device would be small or light enough to be delivered aboard Iran's present ballistic missiles.¹⁵¹ While this

¹⁴⁶ "Implementation of the NPT Safeguards Agreement in the Islamic Republic of Iran," Report by the Director General to the Board of Governors, GOV/2004/83, November 29, 2004, 28; and Albright and Hinderstein, "Iran: Countdown to Showdown," *Bulletin of the Atomic Scientists* (November-December 2004), 67-72.

¹⁴⁷ Kerr, "Iran's Nuclear Activities Limited."

¹⁴⁸ Dafna Linzer, "Iran Is Judged 10 Years from Nuclear Bomb," *Washington Post*, August 2, 2005, A1.

¹⁴⁹ Albright and Hinderstein, "Countdown to Showdown."

¹⁵⁰ Linzer, "Iran is Judged 10 Years from Nuclear Bomb."

¹⁵¹ See the discussion of Jeffrey Lewis and Alexander Montgomery, "Can North Korea Mate a 'Simple' Fission Device to the Taepo Dong 2?" April 30, 2005, <http://www.armscontrolwonk.com/index.php?id=578>.

would certainly reinforce the credibility of an Iranian nuclear deterrent, even a difficult-to-deliver nuclear device would cause all but the most determined hawks to pause before contemplating the use of force against Iran.

F. CONCLUSION

Iran appears to represent Khan's first nuclear sale. A unique confluence of policymakers combined with loose safeguards may have allowed Khan to get his nuclear enterprise off of the ground. His cooperation with Iran continued even after those policymakers who might have approved such a venture had left the scene. His cooperation with Iran continued even after Pakistani-Iranian relations had soured in the mid-1990s. It appears that Khan was in control, and continued cooperation largely for his own benefit.

Kenneth Waltz argued in his support for nuclear optimism, "We do not have to wonder whether they will take good care of their weapons. They have every incentive to do so." Pakistan had every incentive not to assist Iran with its nuclear program. It risked a direct loss of security, by gaining a nuclear neighbor, and an indirect threat, caused by a loss of faith in its nuclear stewardship. At best, it could hope that Iran would be so pleased by the nuclear exchange that the Iranian-Pakistani relationship would be transformed into a permanent alliance. Perhaps, it could hope that the assistance would be sufficient to cement friendship, but insufficient to provide Iran with a real nuclear weapon. Risk-taking based on shaky beliefs is not predicted by the optimist argument.

The optimists' faith is further shaken if we assume that the state did not authorize the transfer. If rogue actors can make significant decisions with nuclear technology, then the faith of optimists that states are sensitive to their own demise instead devolves into a faith that individuals will make good choices. Khan is proof that individuals often take decisions that are very dangerous for themselves and others.

The above narrative also demonstrates that viewing the state as a unitary actor has its limits. Pakistan and other states are characterized by personalized rule. To argue that the Pakistani state approved Khan's nuclear cooperation with Iran is almost certainly an overstatement. It is possible that the state authorized some very limited cooperation, that a small group of like-minded individuals approved broader cooperation, and that Khan himself used that policy opening to pursue extensive and lucrative assistance. Secret

decisions made without outside inputs may be dangerously wrong. In this case, a unique constellation of individuals—where some had inclinations to cooperate with Iran, where others were predisposed to give Khan autonomy, and where still others were inclined to look the other way—may have approved the cooperation tacitly.

The next case, North Korea, may provide a different story. Nuclear assistance to North Korea occurred in the context of a broader strategic partnership between Islamabad and Pyongyang, where sensitive nuclear technology was often shared. Was Khan's cooperation with North Korea for the benefit of Pakistan, for the benefit of Khan Research Laboratories, or to benefit Khan? The next chapter explores some of these possibilities.

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IV. THE PROBLEM OF BACKGROUND NOISE: KHAN'S ASSISTANCE TO NORTH KOREA

A. INTRODUCTION

The previous chapter discussed Khan's first known transfer of nuclear knowledge to a non-nuclear weapons state. Iran had little to offer Pakistan except for political support and cash.¹⁵² While evidence of tangible political support from Iran is scarce (which might indicate a greater degree of involvement by the Pakistani state), there is evidence of cash flows from Tehran to Khan and his associates.¹⁵³ Khan's next nuclear transfer appears to have been to North Korea. Pyongyang had more to offer Pakistan that might be of strategic interest to Islamabad and Rawalpindi. In particular, North Korea's experience with liquid-fueled missiles and handling plutonium might have been useful to the Pakistani state. This has led to understandable speculation that some sort of nuclear barter might have been arranged between Pyongyang and Islamabad, with Khan acting as the middleman for the deal.¹⁵⁴

The North Korean case also differs from Iran (the previous chapter) and Libya (the next case study) because of the paucity of information about the status of the North Korean program. In the Iranian and Libyan examples, significant data has been made available to the public because of IAEA inspections in both countries and the Libyan decision to completely, verifiably, and irreversibly dismantle its program. With regards to the North Korean program, the limited information available in open sources has been a combination of statements by Pakistani officials regarding the Khan investigation and leaks from government officials to the press.

This chapter has modest objectives in light of the meager data available. It summarizes the publicly available information about what was transferred to North Korea

¹⁵² Iran also had oil reserves, of course, though Pakistan has relied historically on Saudi Arabia for its energy needs.

¹⁵³ For instance, B. S. A. Tahir says that a shipment of centrifuges in the 1994-1995 timeframe to Iran was paid for with briefcases of *dirhams*, the currency of the United Arab Emirates.

¹⁵⁴ For examples, see Daniel A. Pinkston, "When Did WMD Deals between Pyongyang and Islamabad Begin," Research Story of the Week, Center for Nonproliferation Studies, Monterey Institute for International Studies (October 21, 2002), <http://cns.miis.edu/pubs/week/021028.htm>; and Gaurav Kampani, "Second Tier Proliferation: The Case of Pakistan and North Korea," *Nonproliferation Review* 9, no. 3 (Fall-Winter 2002): 107-16.

and how significant such transfers might be. It demonstrates that a nuclear-for-missile technology exchange, while possible, is not the only way to read the Pakistani-North Korean relationship. It offers alternative, but unproven, explanations. It examines the prospect that North Korea might have provided plutonium or plutonium expertise to Pakistan. It looks at evidence suggesting Pakistan may have assisted North Korea with uranium conversion, suggesting broad state-to-state nuclear cooperation. It concludes by arguing that none of the state-level explanations are entirely compelling, and more weight should be given to individual or institutional rationales for Khan's assistance to Pyongyang.

B. THE NATURE AND SIGNIFICANCE OF KHAN'S ASSISTANCE

Pakistani officials have discussed the nature of Khan's nuclear assistance with North Korea, both directly to the press and with U.S. officials. A. Q. Khan, in a signed statement, reportedly accepted responsibility for "supplying old and discarded centrifuge and enrichment machines together with sets of drawings, sketches, technical data and depleted Hexafluoride (UF6) gas to North Korea."¹⁵⁵ Khan also may have provided North Korea with the "shopping list" of all of the equipment necessary to produce the machines.¹⁵⁶ One can wonder whether it is the same list that Iran used to avoid paying the high prices in Khan's package deal and go directly to the European, Chinese, and Russian suppliers. The timing of the cooperation has been somewhat uncertain. Third-hand reports—Khan supposedly told Pakistani investigators who then informed U.S. officials who then leaked it to the press—have said that Khan first approached North Korea in the late 1980s, but did not begin major shipments until the late 1990s.¹⁵⁷ This

¹⁵⁵ "Re-imposition of sanctions feared," *Dawn*, February 5, 2004. The source of the article, an unnamed "official" may be Lt. Gen. Khalid Kidwai, the Director-General of Pakistan's Strategic Plans Division. Western news accounts note that Kidwai briefed the Pakistani press for over 2 hours in early February on the status of the investigation into Khan's activities. John Lancaster and Kamran Khan, "Musharraf Named in Nuclear Probe," *Washington Post*, February 3, 2004. The Lancaster and Khan article imply that the Kidwai briefing occurred on February 2. While the dateline in the *Dawn* article is for February 4, in the text of the article it indicates that the official spoke "here on Wednesday (partly covered in Monday issue.)"

¹⁵⁶ David E. Sanger, "Pakistani Says He Saw North Korean Nuclear Devices," *New York Times*, April 13, 2004.

¹⁵⁷ *Ibid.*

coincides with Pakistani statements that the first “orders were placed for the production of components for centrifuge machines” starting in 1997, with the first shipments occurring a year later.¹⁵⁸

In September 2005, President Musharraf said that Khan exported “probably a dozen” centrifuges to North Korea. He also claimed there was no evidence that Khan had passed “bomb designs to others” besides the Libyans.¹⁵⁹ A dozen centrifuges would have been insufficient to produce enough highly enriched uranium for a nuclear bomb. However, they could be used as a template from which copies could be made. Musharraf also indicated that Khan might have sent uranium hexafluoride to North Korea.¹⁶⁰ At the same time, the Pakistani president argued that since Khan’s responsibility was uranium enrichment he could not have assisted North Korea in overcoming other challenges to the bomb. He said, “Dr. A.Q. Khan’s part is only enriching the uranium to weapons grade. He does not know about making the bomb, he does not know about the trigger mechanism, he does not know about the delivery system.” If North Korea had developed the bomb, they “must have got it themselves or somewhere else—not from Pakistan.”¹⁶¹

Musharraf’s description of Khan’s capabilities was erroneous. As noted in chapter two, KRL competencies had expanded significantly beyond uranium enrichment, though centrifuge enrichment certainly remained its primary mission. There are indications that in the 1980s, Khan also had gained proficiency in developing the trigger mechanism, uranium re-conversion, and bomb design and assembly.¹⁶² Interestingly, Musharraf’s statements to the press may not have been intentionally disingenuous. It seems equally possible that even at this late date there is confusion at the highest levels of the government of Pakistan about the activities of the nuclear labs during the compartmentalized and covert 1980s. Khan may have transferred nuclear know-how in these other areas to North Korea, though it is also possible that Khan transferred

¹⁵⁸ “Re-imposition of sanctions feared,” *Dawn*, February 5, 2004.

¹⁵⁹ David E. Sanger, “Pakistan Leader Confirms Nuclear Exports,” *New York Times*, September 13, 2005.

¹⁶⁰ Salman Masood and David Rohde, “Pakistan Now Says Scientist Did Send Koreans Nuclear Gear,” *New York Times*, August 25, 2005.

¹⁶¹ Rehman and Alam, “More on Musharraf Says Khan Offered Centrifuges, Designs To N. Korea.”

¹⁶² Shahid-ur-Rehman, *Long Road to Chagai* (Islamabad: Print Wise, 1999), 6.

technology and expertise only relating to his specialty of centrifuge enrichment. Musharraf admitted he had no evidence regarding whether Khan transferred the bomb designs to North Korea.¹⁶³

The U.S. government is concerned that North Korea has gained centrifuge technology, providing it with a much less detectable path to fissile material. Mitchell B. Reiss and Robert L. Gallucci, who occupied senior State Department positions in the Bush and Clinton administrations respectively, have written that North Korea has imported at least some of the components necessary to assemble a large centrifuge cascade. They cite evidence of North Korean efforts to acquire the materials necessary for a significant number of centrifuges and uranium hexafluoride feed and withdrawal systems. They refer specifically to an intercepted 22-ton shipment of high-strength aluminum tubes destined for North Korea from a German firm. Ostensibly, these tubes were for use in a centrifuge program—though such assumptions have caused problems for U.S. intelligence in the past. Most significantly, they claim not just North Korean efforts, but apparent successes in procurement: “In mid-2002, the Bush administration obtained clear evidence that North Korea had acquired material and equipment for a centrifuge facility that, when complete, could produce enough weapons-grade uranium for two or more nuclear weapons per year.”¹⁶⁴

With that said, as Corey Hinderstein of the Institute for Science and International Security has noted, intercepting a large number of materials does not necessarily indicate a large program, just as intercepting a small number of materials is not necessarily evidence of a small program. Further, procurement success must still be converted into a technological capability.¹⁶⁵ Such caveats are necessary following erroneous U.S. intelligence estimates regarding Iraqi weapons of mass destruction.¹⁶⁶

¹⁶³ Sanger, “Pakistan Leader Confirms Nuclear Exports.”

¹⁶⁴ Reiss and Gallucci, “Red-Handed,” *Foreign Affairs* (March-April 2005): 142.

¹⁶⁵ Hinderstein in James Russell and Christopher Clary, Conference Report on “Globalization and WMD Proliferation Networks: Challenges to U.S. Security,” June 29-July 1, 2005, http://www.ccc.nps.navy.mil/events/recent/WMDConferenceAug05_rpt.asp; also Commission on the Intelligence Capabilities of the United States Regarding Weapons of Mass Destruction, *Report to the President of the United States* (Washington, D.C.: GPO, March 31, 2005), 260-1.

¹⁶⁶ See WMD Commission, *Report to the President*, chap. 1.

Unlike the Iranian case discussed in the previous chapter, Pakistani assistance did not overcome a key barrier between North Korea and a nuclear weapon. Indeed, if North Korea has reprocessed its 8,000 spent nuclear fuel rods, it would have sufficient fissile material for four to six nuclear devices irrespective of what Khan might have provided.¹⁶⁷ Before 1992, North Korea also produced enough plutonium for perhaps two additional nuclear devices.¹⁶⁸ So, even without a uranium program, North Korea would have the potential to produce up to eight nuclear explosive devices, though difficulties in reprocessing might decrease the weapons-grade plutonium available for bomb making. Under the best-case scenario (for the United States), these reprocessing difficulties could mean that North Korea only has sufficient weapons-grade material for 1 or 2 devices.¹⁶⁹ Such a low figure is supported by at least one prominent North Korean defector.¹⁷⁰

Past Pakistani assistance is significant because it increases dramatically the challenge of verifying the status of the North Korean nuclear program. The United States and its allies apparently have had great difficulty in locating North Korean nuclear facilities, and in particular any centrifuge cascades the North might have assembled.¹⁷¹ As noted in the introduction of this thesis, the plutonium route required large facilities that could be easily observed. By introducing centrifuge technology onto the Korean peninsula, A. Q. Khan's transfers have improved the ability of North Korea to conceal its

¹⁶⁷ This estimate was provided by Mohammad ElBaradei, Director-General of the IAEA, in an interview. David E. Sanger and William J. Broad, "North Korea Said to Expand Arms Program," *New York Times*, December 6, 2004.

¹⁶⁸ See David Albright, "North Korea's Current and Future Plutonium and Nuclear Weapon Stocks," *ISIS Issue Brief*, January 15, 2003, <http://www.isis-online.org/publications/dprk/currentandfutureweaponsstocks.html>.

¹⁶⁹ Peter James Spielmann, "Reports on N. Korea Nukes May Lack Proof," *Associated Press*, October 1, 2004.

¹⁷⁰ Song Su'ng-ho, "Scoop: A Deputy to the North Korean Supreme People's Assembly Defects to the RoK and Makes Important Testimonies on the Nuclear Development," *Chosun* (Seoul), 120-3, *FBIS Translated Text*, report no. KPP20050718000019; also see discussion in Jeffrey Lewis, "How Much Pu in North Korean Bomb?" (July 30, 2005), <http://www.armscontrolwonk.com/709/how-much-pu-in-a-north-korean-bomb>.

¹⁷¹ David E. Sanger and William J. Broad, "U.S. Asking China to Increase Pressure on North Korea to End Its Nuclear Program," *New York Times*, February 9, 2005; also see Robert S. Norris and Hans M. Kristensen, "Nuclear Notebook: North Korea's Nuclear Program, 2005," *Bulletin of the Atomic Scientists* (May-June 2005), 64-7.

nuclear activities. This fact has complicated greatly the ability of the parties to come to a diplomatic and peaceful solution to the North Korean nuclear problem.¹⁷²

C. A NUCLEAR BARTER?

Khan's transfers appear to have eased North Korea's nuclear effort. They have impinged upon U.S. national interests in a region of vital concern. Further, such assistance, if revealed, would certainly draw the ire of Japan, a key foreign aid provider for Pakistan. Islamabad faced significant risks if such assistance was discovered. Why did Khan assist a non-Muslim country, thousands of miles away? Did Pakistan enter into a nuclear-for-missile technology barter? Was their broader nuclear cooperation between Islamabad and Pyongyang? Or was this the case of Khan acting to benefit himself or his laboratory? Simply put, there is not sufficient information to answer any of these questions definitively. The available evidence appears to lean, however, toward Khan acting as an individual or as a laboratory head, rather than as an agent of the Pakistani government. The proof of state involvement does not yet outweigh signs that Khan was a rogue actor. This chapter lists potential indicators that would support (or rebut) each scenario. As more evidence is available in the public domain, future analysts may be able to draw firmer conclusions about the level of state complicity in transfers to North Korea.

1. A Nuclear-for-Missile Technology Swap

In the 1980s, Pakistan had secured F-16s from the United States in exchange for its cooperation against the Soviets in Afghanistan. In October 1990, after 40 F-16s were delivered, less than half of the total order, U.S. aid to Pakistan was halted out of concern over Pakistan's nuclear weapons efforts.¹⁷³ The ability of Pakistan to deliver its nuclear weapon was called into question. The task to develop a delivery vehicle was made all the more urgent since India had tested the Agni ballistic missile in May 1989. From the highest levels of the Pakistani government, a call was issued for the strategic organizations to develop or procure a delivery vehicle. As with other strategic missions,

¹⁷² See "Parties Concur N.K. Has HEU Material, But Disagree On Program's Progress: Hill," *Yonhap* (Seoul), September 29, 2005, FBIS report no. KPP20050929971002.

¹⁷³ Dennis Kux, *The United States and Pakistan, 1947-2000: Disenchanted Allies* (Baltimore, Md.: Johns Hopkins University Press, 2001), 309-10.

PAEC and KRL competed to be the first to deliver. The winner of this technological race would benefit from significant public prestige.

In the missile race, the PAEC sought to continue a historic partnership with the Chinese military and scientific establishments. Some sources suggest that agreement was reached between Pakistan and China to cooperate on solid-fueled missiles as early as 1987.¹⁷⁴ If correct, this would indicate Sino-Pakistani cooperation early in the life of the M-9 and M-11 programs, before the first Chinese flight test of either missile.¹⁷⁵ Gordon Oehler, former head of the Director of Central Intelligence's Center for Weapons Intelligence, Nonproliferation, and Arms Control, testified that Pakistan acquired a "training M-11 ballistic missile" in 1990 and received 34 M-11s in November 1992.¹⁷⁶ In the mid-1990s, it appears that China also assisted Pakistan in constructing a facility to manufacture M-11 missile components.¹⁷⁷

If Pakistan did receive complete M-11s, it was slow in brandishing them. Given South Asia's culture of one-upmanship, this is somewhat confusing. However, fears of sanctions—sanctions that might embarrass Beijing—could have delayed Pakistan from publicly testing the M-11, or indigenous derivatives. The M-11 is widely believed to be the basis for the Pakistani Hatf-III.¹⁷⁸ However, the first reported "Hatf-III" test in July 1997 is doubly confusing. While referred to as the Hatf-III in contemporary press accounts, those same accounts list it as having a much greater range—800 kilometers—

¹⁷⁴ See, for instance, Federation of American Scientists, "Pakistan Nuclear Weapons - A Chronology," <http://www.fas.org/nuke/guide/pakistan/nuke/chron.htm> (updated June 3, 1998); Nuclear Threat Initiative, "Pakistan: Missile Import/Export," http://www.nti.org/e_research/profiles/Pakistan/Missile/3297.html (updated December 2003).

¹⁷⁵ "CSS-6 (DF-15/M-9)" and "CSS-7 (DF-11/M-11)," in *Jane's Strategic Weapon Systems* (posted June 8, 2005).

¹⁷⁶ Gordon Oehler, Testimony to the Senate Foreign Relations Committee, Hearing on "Proliferation of Chinese Missiles," June 11, 1998. There were contemporary accounts of this suspected transfer. For instance, Jim Mann, "China Said to Sell Pakistan Dangerous New Missiles," *Los Angeles Times*, December 4, 1992.

¹⁷⁷ R. Jeffrey Smith, "China Linked to Pakistani Missile Plant," *Washington Post*, August 25, 1996.

¹⁷⁸ See Gaurav Kampani, "Pakistan: Missile Overview," Nuclear Threat Initiative website, http://www.nti.org/e_research/profiles/Pakistan/Missile/ (updated February 2005); also Joshua Williams, "World Missile Chart," Carnegie Endowment for International Peace Nonproliferation Program website, <http://www.carnegieendowment.org/npp/ballisticmissilechart.cfm> (accessed November 3, 2005). Discussions of the Pakistani missile program are significantly complicated by inconsistent labeling of Pakistani missiles, by both Pakistani and outside sources.

than the standard M-11.¹⁷⁹ Indian press accounts argue that this missile is an M-9 derivative.¹⁸⁰ More authoritative Pakistani sources, like that of Brigadier Naeem Salik, director of Arms Control and Disarmament Affairs for Pakistan's SPD, do not take note of the July 1997 test.¹⁸¹

It appears that the July 1997 test was not a flight test, but rather a ground-based test firing of the engine.¹⁸² Non-governmental analysts and the press, however, have confused the situation considerably by misinterpreting what was meant by the word "test."¹⁸³ This timeline is important. If Pakistan already had conducted a test flight of a nuclear-capable, solid-fuel medium-range ballistic missile, why would it be so desperate to acquire liquid-fueled North Korean technology? The point is that Pakistan had not successfully flight-tested a solid-fueled alternative when the alleged nuclear assistance to North Korea began. The first "real" Hatf-III flight test occurred on May 26, 2002, in the midst of the tense Indo-Pakistani military standoff of 2001-2002. The Ghaznavi missile, as the Hatf-III was called at the time of the test, had an announced maximum range of 290 kilometers, almost exactly equal to open-source reports of the M-11's range (300 kilometers).¹⁸⁴ The slightly shorter announced range was likely a modest attempt not to flout the Missile Technology Control Regime's ban on transferring missiles with ranges

¹⁷⁹ The first public mention of the Hatf-III test apparently was in the *Nawa-i-waqt*, July 2, 1997. I have not been able to find an original copy or translation of that article. The confusion appears to be between language about a "test-firing" and a "flight test." "Pakistan Confirms 'Test-Firing' of New Missile," *Agence France Presse*, July 3, 1997. A reference to the July 1997 test appears in Lt. Gen. (retd.) Sardar F. S. Lodi, "Pakistan's Missile Technology," *Pakistan Defence Journal* (May 1998), <http://defencejournal.com/may98/pakmissiletech.htm>.

¹⁸⁰ "Delhi Reports Pakistan Test Fired Medium-Range Missile," *All India Radio Network* (Delhi), July 2, 1997, *FBIS Transcribed Text*, FTS19970702000584; Ranjit Kumar, "And if the Pakistani Missile is Chinese?" *Navbharat Times* (Delhi), July 4, 1997, *FBIS Translated Text* FTS19970706000165; and K.N. Daruwalla, "Missile or a Mirage?" *The Economic Times* (Delhi), July 12, 1997, *FBIS Transcribed Text*, FTS19970712000201.

¹⁸¹ Brig. Naeem Salik, "Missile Issues in South Asia," *Nonproliferation Review* (Summer 2002): 52.

¹⁸² Conversations with retired senior Pakistani military official. Some Indian press accounts also reflect this understanding: "[C]redible reports suggested that the 'Hatf-III' test was actually an engine test." Amit Baruah, *The Hindu* (Chennai), April 7, 1998.

¹⁸³ For instance, "A History of Pakistan's Missile Program," *Associated Press Worldstream*, October 4, 2002, says, "In July Pakistan tests the Hatf-III with a range of 800 kilometers (480 miles)." It uses the same "test" verb to describe the flight test of the Hatf-V/Ghauri a year later. Gaurav Kampani, who argues that the test in 1997 was of a M-9 derivative, nonetheless implies that the July test was a flight test. He notes that while the first Chinese flight test was in 1988, there was no Pakistani "test" until 1997. Kampani, "Pakistan: Missile Overview."

¹⁸⁴ "Missile Tests," *Pakistan Newswire*, May 26, 2002.

at or above 300 kilometers. The M-11, while nuclear-capable in terms of its potential payload, is limited as a delivery vehicle by its relatively short range.¹⁸⁵ Significantly, it cannot deliver a warhead onto New Delhi from Pakistani territory, though its greater accuracy improves its utility against closer military targets.¹⁸⁶

Throughout the 1990s, the PAEC was working simultaneously with China on longer range, solid-fuel missile technology for Pakistan, perhaps deriving from the M-9 missile. The M-9 can hold more distant targets at risk, with a significantly longer range of approximately 600 kilometers with a payload of 500 kilograms.¹⁸⁷ There remains some debate about whether entire M-9s or just M-9 technology was transferred to Pakistan. Machinery for the production of M-9s may also have been received during the mid-1990s.¹⁸⁸ The July 1997 rocket test was probably for this development program.¹⁸⁹ The first flight test of the Hatf-IV, however, did not occur until April 14, 1999. The Shaheen, the name given to the Hatf-IV, was announced with a range of 600 kilometers and a payload of 1,000 kilograms.¹⁹⁰

So PAEC worked throughout the 1990s to acquire a delivery vehicle. It only was able to flight test a credible candidate missile by April 1999. Khan and KRL beat PAEC by more than a year. On April 6, 1998, the 1500-km range Ghauri-1, a liquid-fueled, Nodong-derivative, was flight-tested. A contemporary Pakistan television broadcast captures the mood: “In his message to Dr. A. Q. Khan, Prime Minister Mohammad Nawaz Sharif has warmly congratulated Dr. Khan and his team of scientists and

¹⁸⁵ “Missile Tests,” *Pakistan Newswire*, May 26, 2002.

¹⁸⁶ See Office of the Secretary of Defense, U.S. Department of Defense, *Proliferation: Threat and Response* (Washington, D.C.: GPO, January 2001), 29.

¹⁸⁷ “CSS-6 (DF-15/M-9),” in *Jane’s Strategic Weapon Systems*.

¹⁸⁸ Kampani, “Pakistan: Missile Overview”; also “Indian Journal Reports Pakistan Soon to Have Hi-Tech Missile Facility,” *BBC Summary of World Broadcasts*, June 2, 1996.

¹⁸⁹ For instance, Lt. Gen. Lodi says that the missile tested in July 1997 had a 600-km range with a 500-kg warhead and a circular error probable (CEP) of 0.1 percent. The first two figures are identical to open-source reports on the M-9. Jane’s lists the M-9’s CEP as 300 meters, which is the same order of magnitude as Lodi’s figure. See “CSS-6 (DF-15/M-9),” in *Jane’s Strategic Weapon Systems*; and Lodi, “Pakistan’s Missile Technology.” Gaurav Kampani also draws this conclusion. Kampani, “Pakistan: Missile Overview.”

¹⁹⁰ Sami Zubeiri, “Pakistan Test Fires Second Ballistic Missile within 24 Hours,” *Agence France Presse*, April 15, 1999. There is considerable variability in the listed range of the Hatf-IV. This may be from different assumptions of warhead weight and/or because of improvements or modifications made to the initial airframe.

engineers, as well as the entire nation on this historic achievement.”¹⁹¹ Looking back, Brigadier Naeem Salik of Pakistan’s Strategic Plans Division discussed the strategic significance: “The test firing... was a major breakthrough because this missile... provided Pakistan with a real deterrent against India’s growing missile capability.”¹⁹² Khan had won the race, and had won popular acclaim. Had Khan’s Ghauri been part of a broader deal? Had Pakistan provided North Korea with centrifuge technology in order to field a tested missile sooner?

Pakistani-North Korean cooperation on ballistic missile technology began perhaps as early as 1992.¹⁹³ Benazir Bhutto has admitted publicly that she obtained guarantees of missile technology during her December 1993 visit to Pyongyang. But she has denied any missile for nuclear technology swap occurred: “We did not obtain missiles in exchange for nuclear technology. Whatever the technology was, we bought it with money,” she said.¹⁹⁴ Bhutto is savvy and self-serving politician, whose statements should be taken with a grain of salt. Nevertheless, there is scant evidence to contradict her version of events. One anonymous Bush administration official described the nuclear-for-missile technology swap as a proliferation “urban legend.”¹⁹⁵ In fact, Bhutto’s event is somewhat bolstered for her willingness to admit that Pakistan acquired Nodong missile technology from North Korea, when officially the Ghauri missile relies only on indigenous technology.

Analysts suspect a swap rather than just Khan’s malfeasance for four reasons, none wholly convincing. First, it is intuitive. North Korean-Pakistani cooperation on

¹⁹¹ “Pakistan Tests Ghauri Missile, Offers Olive Branch to India,” [text of report by Pakistan TV on April 6, 1998] *BBC Worldwide Monitoring*, April 6, 1998.

¹⁹² Salik, “Missile Issues in South Asia,” *Nonproliferation Review* (Summer 2002): 52.

¹⁹³ Brief overviews of Pakistani-North Korean missile cooperation can be found in Joseph S. Bermudez, Jr., *A History of Ballistic Missile Development in the DPRK*, Occasional Paper no. 2 (Monterey, Calif.: Monterey Institute for International Studies, Center for Nonproliferation Studies, November 1999), 21-24; also Kampani, “Second Tier Proliferation,” 110.

¹⁹⁴ Eishiro Takeishi, interview with Benazir Bhutto, “Pakistan’s Secret Deal: Obtained Technology, but Lost Trust,” July 18, 2004, translated in “Asahi: Ex-Premier Bhutto Says Pakistan Bought Missile Technology From DPRK,” *FBIS Report no. JPP20040718000011*; also “Missile Technology Bought from N. Korea: Benazir,” *Dawn* (Karachi), July 19, 2004; and Gary Thomas, “Former Prime Minister Says Pakistan Had Nuclear Capability Long Before Nuclear Tests,” *Voice of America*, March 3, 2005, <http://www.voanews.com/english/2005-03-03-voa4.cfm>.

¹⁹⁵ Bokhari, et al, “Pakistan’s ‘Rogue Nuclear Scientist,’” April 6, 2004.

missiles was well known by every key Pakistani policymaker—several of whom traveled to Pyongyang to ensure its continuation. It seems likely, analysts reason, that if nuclear cooperation was occurring it would also occur with the approval of the Pakistani civilian and military leadership. Second, perhaps Pakistan could not pay outright for the nuclear missiles. Daniel A. Pinkston of the Center for Nonproliferation Studies at the Monterey Institute of International Studies suggests that Pakistan's lack of foreign reserves in 1996 led to a decision to pay for the delivery of the Nodong missile system.¹⁹⁶ Third, Khan and his friends have reportedly said that the Pakistan military was aware of the nuclear assistance. Khan has claimed, according to the anonymous "investigators" and "friends of Khan" that dot the press reports out of Islamabad, that three different Army chiefs were aware of his nuclear deals with Pyongyang: Gen. Abdul Waheed (1994-1996), Gen. Jehangir Karamat (1996-1998), and Gen. Pervez Musharraf (1998-present).¹⁹⁷

This is related to the fourth and final rationale: the military has had a dominant role in nuclear oversight since Zia ousted Zulfikar Ali Bhutto in 1977. It seems inconceivable that Khan would undertake such a venture without approval from authorities. As Gaurav Kampani, formerly of the Center for Nonproliferation Studies, argues, "[A]lthough the nuclear establishment enjoys a high degree of internal autonomy in decisionmaking, that autonomy is not absolute; the nuclear scientists operate within the confines of a mandate, which makes them subject to supervision by the national command authority." Kampani concludes that such rogue action is even more unlikely given the stakes involved: "[I]t is difficult to imagine how Dr. A. Q. Khan could have made such a momentous decision independently without the benefit of a debate, albeit a limited one, at the highest levels of Pakistani government."¹⁹⁸

It is impossible to say with certainty whether decision-makers in Islamabad and Rawalpindi a nuclear-for-missile technology exchange with Pyongyang. There are five reasons to think that they did not. First, as noted above, Benazir Bhutto has claimed that the missile cooperation was based on cash payment, rather than nuclear barter.

¹⁹⁶ Daniel A. Pinkston, "When Did WMD Deals Between Pyongyang and Islamabad Begin?" (updated February 27, 2003), <http://cns.miis.edu/pubs/week/pdf/nkpaki2.pdf>.

¹⁹⁷ Lancaster and Khan, "Musharraf Named in Nuclear Probe," *Washington Post*, February 3, 2004.

¹⁹⁸ Kampani, "Second Tier Proliferation," 111-2.

Second, while it is true that foreign reserves sank to dire levels in 1996, it is a long leap to assume that Pakistan could find no other way to finance missile acquisitions than by a technology exchange. It is difficult to quantify what North Korean missile technology was transferred to Pakistan. Joseph Bermudez has referred to an agreement in November 1995 “to provide Pakistan with key components from either the No-dong or Taep’o-dong programs, about 12-25 No-dong missiles, and at least one [transporter erector launcher] TEL or [mobile erector launcher] MEL.”¹⁹⁹ Bermudez further asserts that “a majority” of the items were delivered by the spring of 1996.²⁰⁰ While estimates of the cost of Nodong missiles are not available, the shorter range Hwasong 5 and 6 have been estimated to cost around \$1.5 to \$2 million each, while the longer range Taepodong I has been priced at \$6 million apiece.²⁰¹ Assuming, say, a \$4 million price tag for each Nodong would value the missile transfer at between \$48 and \$100 million. To put that figure in context, estimates by the Stockholm International Peace Research Institute value Pakistan’s arms imports in the 1995-1996 timeframe at \$819 million.²⁰² The overall defense budget in the mid-1990s was around \$3 billion annually.²⁰³ While purchasing the Nodong missiles would have been a non-trivial expenditure for Pakistan, it does not appear unachievable given Pakistan’s overall defense spending.

Third, even if Pakistan’s ability to compensate North Korea was limited monetarily, Pakistan did not have to trade the nuclear “crown jewels” for decades-old liquid-fuel missiles. It was not as if Pyongyang was stingy with its missile technology. Egypt, Iran, Libya, Syria, and Yemen were able to reach agreement to purchase missiles of North Korean origin.²⁰⁴ North Korea apparently offered missile technology to Nigeria.²⁰⁵ Joseph Bermudez notes that prior to the nuclear revelations, “the general

¹⁹⁹ Bermudez, *A History of Ballistic Missile Development in the DPRK*, 24.

²⁰⁰ Ibid.

²⁰¹ Ibid., 19; also “North Korea’s Taepodong I Missile Priced at \$6 Million,” *Korea Times*, October 9, 1999.

²⁰² “Arms Transfers to India and Pakistan, 1994-2004,” SIPRI Arms Transfers Database, http://www.sipri.org/contents/armstrad/atind_pakdata.html.

²⁰³ “Pakistan,” SIPRI Military Expenditure Database, http://www.sipri.org/contents/milap/milex/mex_database1.html.

²⁰⁴ Williams, “World Missile Chart.”

²⁰⁵ “Nigeria Seeking N Korea Missiles,” *BBC News*, January 29, 2004, <http://news.bbc.co.uk/2/hi/africa/3438539.stm>.

consensus [was] that North Korea had received a small amount of hard currency, access to Pakistani missile technology and a venue to continue flight-testing the No Dong.”²⁰⁶ This non-monetary compensation of North Korea almost certainly did take place, irrespective of whether centrifuge technology was in the mix. If Pakistan did pay cash, as Benazir Bhutto has claimed, and if it provided North Korea with assistance on missile technology and flight-testing, why throw centrifuge technology into the mix?

Fourth, evidence of Pakistani-North Korean transactions are not evidence of Pakistani-North Korean nuclear collaboration. For instance, cargo flights between Pyongyang and Rawalpindi are often cited as proof of some sort of conspiracy.²⁰⁷ There was broader Pakistani-North Korean cooperation. In addition to ballistic missiles and their components, which alone could explain shipments back and forth, North Korean and Pakistani scientists collaborated on other military equipment, including surface-to-air missiles and artillery.²⁰⁸ This creates a “signal-to-noise” problem (for both foreign intelligence analysts and Pakistani overseers). The conventional trade could have masked nuclear trafficking. Distinguishing the contents of crates on the tarmac is an unenviable task. For foreign intelligence agencies, only human intelligence assets at the point of origin or the destination could report that information. For Pakistani overseers, they would have needed to search cargo bound for North Korea.

Fifth, and finally, Pakistan’s Inter-Services Intelligence did apparently raid a North Korea-bound chartered aircraft in 2000 and did not find anything proving Khan’s malfeasance.²⁰⁹ The fact there was an unannounced search would seem to indicate that Pakistani authorities did not regularly screen such cargo. Further, a raid seems to be a

²⁰⁶ Bermudez, “Lifting the Lid on Kim’s Nuclear Workshop,” *Jane’s Defence Weekly*, November 27, 2002.

²⁰⁷ See, for instance, William J. Broad, David Rohde and David E. Sanger, “Inquiry Suggests Pakistanis Sold Nuclear Secrets,” *New York Times*, December 22, 2003; also Kampani, “Second Tier Proliferation,” 110.

²⁰⁸ Musharraf has noted Pakistani-Korean cooperation on artillery technology. Rehman and Alam, “More on Musharraf Says Khan Offered Centrifuges, Designs To N. Korea.” KRL also produced a number of conventional weapons systems, particularly in the realm of missiles, mines, electronics, and artillery. See “Dr. A. Q. Khan Research Laboratories, Kahuta: Twenty Years of Excellence and National Service,” in *Dr. A. Q. Khan on Science and Education*, ed. S. Shabbir Hussain and Mujahid Kamran (Lahore: Sang-E-Meel, 1997), 222-9.

²⁰⁹ Lancaster and Khan, “Musharraf Named in Nuclear Probe”; and “Re-imposition of sanctions feared,” *Dawn*, February 5, 2004.

strange exercise to go through if authorities were well aware of Khan's cooperation with North Korea. If one were going to have a staged raid to find evidence, it would be best if one actually found evidence.

What indicators might be helpful to prove or disprove whether a missile-for-nuclear technology swap occurred? Unfortunately, few if any of the indicators will be observable in open sources. Perhaps only a few if any indicators will be available even through classified intelligence sources. Nevertheless, it is still useful to present the potential indicators, if for no other reason than intellectual honesty.

There may be an observable money trail of the North Korea-Pakistani relationship. It seems likely the money trail would be concealed thoroughly by both North Korea and Pakistan through the use of front companies, anonymous bank accounts, and other means of deception. Is there evidence of a significant transfer of currency from Pakistan to North Korea? If so, does such evidence point to a transaction in the ballpark of \$50 to \$100 million, the back-of-the-envelope value of the estimated Nodong transfer. If the evidence indicates a much smaller transaction, this could point to the uranium barter hypothesis. Alternatively, is there evidence of a significant transfer of currency from North Korea to Khan or his associates? The more cash flowed into Khan's personal coffers, the less it looks like a government-to-government deal.

Another set of indicators relates to the Pakistani safety and security procedures. Available indications are that Khan and his senior colleagues had broad independence in their handling of sensitive nuclear technology and components. However, if there were evidence that cargo shipments in and out of Pakistan were screened thoroughly by the military, then military complicity in the nuclear trade would seem more likely. If there were evidence that centrifuges and their components were tightly controlled and inventoried, then official involvement would seem probable.

2. A Uranium-for-Plutonium Technology Swap

Assuming that Pakistan received liquid-fueled missile technology and provided North Korea with cash, a testing site, and indigenous technological expertise, the above discussion argued that a centrifuge-for-missile barter does not make sense. Providing centrifuge technology seems gratuitous in such an exchange. There have been two press

reports—very few given the number of articles generated by print media globally—that have suggested another possibility: Pakistan used plutonium in the May 30, 1998 nuclear test device.²¹⁰ Given limitations in Pakistani plutonium reprocessing capability, one of these stories has suggested that perhaps North Korean plutonium was used in the May 30 test.²¹¹ Assistance with plutonium expertise—not to mention the potential physical provision of the plutonium for a joint nuclear explosive test—would have been much more worthwhile for Pakistan. It might be worth the risk of getting caught assisting Pyongyang.

The May 30 test was figuratively and physically distinct from the earlier Pakistani tests. The test site was located 60 miles from the May 28 testing site. It was conducted in a vertical rather than a horizontal shaft. Pakistan claimed a yield of 15-18 kilotons for the test, while Western experts estimated a yield of 2-6 kilotons.²¹² U.S. aircraft apparently collected air samples after the May tests and brought them back to U.S. laboratories for analysis. Reportedly, Los Alamos National Laboratory's analysis concluded that the air sample "contained low levels of weapons-grade plutonium."²¹³ The sample used by Los Alamos appears to have been lost. There may also have been questions raised about the accuracy of the analysis, including concerns that Los Alamos contaminated the air sample.²¹⁴ A more recent news account has reported that a new consensus has emerged that the sample was not contaminated, and probably had its origin with the May 30 test, perhaps as a plutonium experiment on the side of a uranium-based nuclear explosive device. Quoting an anonymous senior intelligence official, that account argues, "[The plutonium] could only have come from one of two places: China or North Korea... and it seemed like China had nothing to gain" by providing the plutonium to Pakistan.²¹⁵ The potential North Korean lineage of the plutonium—lineage

²¹⁰ Dana Priest, "U.S. Labs at Odds on Whether Pakistani Blast Used Plutonium," *Washington Post*, January 17, 1999; and David E. Sanger and William J. Broad, "Pakistan May Have Aided North Korea A-Test," *New York Times*, February 27, 2004.

²¹¹ Sanger and Broad, "Pakistan May Have Aided North Korea A-Test."

²¹² Ibid.; David Albright, "Pakistan: The Other Shoe Drops," *Bulletin of the Atomic Scientists* (July-August 1998): 24-25; and Terry C. Wallace, "The May 1998 India and Pakistan Nuclear Tests," *Seismological Research Letters* 69 (September 1998): 386-393.

²¹³ Priest, "U.S. Labs at Odds on Whether Pakistani Blast Used Plutonium."

²¹⁴ Ibid.

²¹⁵ Sanger and Broad, "Pakistan May Have Aided North Korea A-Test."

derived by process of elimination—is sometimes combined with reports of North Korean scientists being present at the test cite.²¹⁶ At least one account, with the typical anonymous U.S. and Pakistani official sources, discusses “a 20-member delegation of North Korean engineers and scientists whom Khan had invited to witness Pakistan's first underground nuclear tests on May 28, 1998.”²¹⁷

As the above discussion indicates, the available evidence is very thin and highly circumstantial. After seven years to analyze the data, it seems odd that there would still be as much confusion as the articles seem to indicate. For an open-source analyst, however, there are at least three reasons to be suspicious. First, as was noted earlier, there are apparently questions about the air sample and how it was analyzed. Second, the paucity of the stories seems to indicate the lack of consensus on the issue within government. The diversity of opinions in the anonymous quotes in the articles reinforces the possibility that there is little certainty about the data. The 2004 *New York Times* article also reported that then-National Security Advisor Condoleezza Rice and then-Secretary of State Colin Powell “had no recollection of theories of a joint test.”²¹⁸ Senior policymakers would probably have been informed if a joint test were considered a likely possibility. Third, the presence of plutonium by no means indicates the presence of North Korean plutonium. One anonymous analyst quoted in the 2004 *New York Times* article indicated that there was evidence that the plutonium detected in the sample was “older than the North Korean program.”²¹⁹ It is possible that the plutonium was provided by China, though providing fissile material would be a risky move on Beijing’s behalf. Finally, it is possible that the plutonium was home grown. Pakistan has a pilot-scale, unsafeguarded plutonium reprocessing capability in Rawalpindi, at the Pakistan Institute of Nuclear Science and Technology (PINSTECH). The hot cell facility, called New Labs, reportedly has a nominal reprocessing capacity of about one kilogram of plutonium

²¹⁶ See Sharon A. Squassoni, “Weapons of Mass Destruction: Trade Between North Korea and Pakistan,” *CRS Report for Congress*, no. RL31900 (updated March 11, 2004), 8, fn. 29. For her part, Squassoni notes “there is little public evidence to support” the joint nuclear test theory.

²¹⁷ Paul Watson and Mubashir Zaidi, “Death of N. Korean Woman Offers Clues to Pakistani Nuclear Deals,” *Los Angeles Times*, March 1, 2004.

²¹⁸ Sanger and Broad, “Pakistan May Have Aided North Korea A-Test.”

²¹⁹ Ibid.

per year, though likely with a smaller actual throughput.²²⁰ The limiting function, however, is probably not reprocessing capability as much as the small quantity of unsafeguarded plutonium available to Pakistan in 1998.²²¹ If Pakistan conducted a small-scale “plutonium experiment” along with the May 30 test, it may have been possible that the plutonium was of domestic origin.

3. Other Possible Nuclear Collaboration

As the next chapter discusses, Libya received a total of 1.87 tons of uranium hexafluoride from the Khan network. The source of that material is significant. If it came from North Korea, it would imply that the regime in Pyongyang had less than stellar nuclear stewardship, something of intense concern to policymakers in Washington and Asian capitals as they struggle to deal with the Korean nuclear crisis. If it came from Pakistan, it would imply real difficulties with the ability of Pakistan to protect and account for fissile material, something more serious than losing track of used centrifuge components. The origin of the uranium might also point to the scope Pakistani-North Korean nuclear cooperation.

According to press reports, there seems to be consensus that the cask containing the uranium—the container itself—originated in Pakistan.²²² The debate centers on where the cask has been and where the material inside the cask originated. Apparently, U.S. intelligence officials detected plutonium isotopes on the container that were indicative of plutonium produced at Yongbyon, North Korea.²²³ IAEA tests on the same container apparently did not yield the same plutonium traces.²²⁴ Tests on the uranium hexafluoride itself seem to have concluded that the uranium did not originate in Pakistan

²²⁰ Mark Hibbs, “China Accord Would Turn Up U.S. Heat on Pakistani Reactor,” *Nucleonics Week*, August 14, 1997.

²²¹ For an earlier discussion of the lack of unsafeguarded plutonium, see David Albright and Mark Hibbs, “Pakistan Bomb: Out of the Closet,” *Bulletin of the Atomic Scientists* 48, no. 6 (July-August 1992): 38-43.

²²² Glenn Kessler and Dafna Linzer, “Nuclear Evidence Could Point to Pakistan,” *Washington Post*, February 3, 2005.

²²³ *Ibid.*; and Kessler, “North Korea May Have Sent Libya Nuclear Material, U.S. Tells Allies,” *Washington Post*, February 2, 2005.

²²⁴ Kessler and Linzer, “Nuclear Evidence Could Point to Pakistan.”

or other suspect countries.²²⁵ However, there is no evidence that North Korea has a uranium conversion facility. In other words, there is no evidence that North Korea could create the uranium gas by itself. One possibility is that North Korea sold the raw material to Pakistan, which then converted it and transferred it Libya.²²⁶ B.S.A. Tahir told Malaysian investigators that uranium hexafluoride was shipped onboard a Pakistani plane to Libya in 2001.²²⁷

Here again we are confronted with scant public information, some of it contradictory. If North Korean uranium were converted by Pakistan into uranium hexafluoride, it would indicate a broad degree of nuclear cooperation. While Khan Research Laboratories appears to have had capabilities to convert uranium gas into uranium metal, there is no evidence that Khan had the expertise and equipment to turn yellowcake into uranium tetrafluoride and then onto uranium hexafluoride. If Khan had such a capability, it seems likely he would have offered it to his other clients (Iran and Libya) or potential clients (Iraq). In the public discussions of Khan's proposed assistance to all three countries, there is no evidence that Khan offered assistance with uranium conversion. If Pakistan were assisting North Korea in making uranium hexafluoride, it would likely indicate the involvement of the PAEC, the organization responsible for Pakistan's uranium conversion capability. PAEC involvement would signal broad state-to-state cooperation on nuclear weapons technology.

D. INDIVIDUAL AND INSTITUTIONAL EXPLANATIONS

The previous section explored three potential state-to-state strategic transactions with North Korea. It found none of these scenarios to be definitive or compelling. Analysts have been too quick to conclude with certainty that Pakistani leadership condoned Khan's assistance to North Korea. The missile barter seems like a bad value for Pakistan. The evidence of plutonium during the May 30th nuclear explosive test appears to be questionable, and even if there was plutonium it might not have originated in North Korea. Public information about the uranium hexafluoride delivered to Libya is

²²⁵ David E. Sanger and William J. Broad, "Tests Said to Tie Deal on Uranium to North Korea," *New York Times*, February 2, 2005.

²²⁶ Kessler and Linzer, "Nuclear Evidence Could Point to Pakistan."

²²⁷ David E. Sanger and William J. Broad, "Using Clues from Libya to Study a Nuclear Mystery," *New York Times*, March 31, 2005.

scarce and contradictory. The previous section also outlined indicators that would point toward greater state knowledge and authorization. If Pakistan paid less than is assumed for North Korean missile technology, we should be suspicious. If there were routine searches of KRL shipments leaving the country or if there were tight (non-KRL) controls on centrifuges and uranium hexafluoride, it would indicate state complicity. If North Korean plutonium were used in the May 30th test, it would demonstrate much broader nuclear cooperation than assumed here. Finally, if Pakistan was converting North Korean uranium yellowcake into uranium hexafluoride, the problem clearly extends beyond KRL and into other organs of the Pakistani state.

Without that evidence, perhaps a more parsimonious explanation is possible. Khan had broad autonomy as head of Khan Research Laboratory. In all likelihood, there was poor state control of critical nuclear technologies and components, including centrifuges. Khan could ship things into and out of the country with little oversight, particularly before the creation of the Strategic Plans Division in 1999. In this scenario, Khan began to assist North Korea in the late 1990s for personal gain. His own importance was diminishing since PAEC, not KRL, was responsible for weaponizing Pakistan's deterrent. Khan might have assisted North Korea for personal benefit, solely in order to enrich himself and his associates. Alternatively, Khan might have assisted North Korea to speed up deliveries of liquid-fuel missile technology, allowing Khan to test the Ghauri a full year before the PAEC could field a solid-fuel alternative.

E. CONCLUSION: THINKING ABOUT RESPONSIBILITY

Gaurav Kampani, in his discussion of the Pakistani-North Korean relationship, concludes, “[E]ven in the unlikely scenario that Dr. A. Q. Khan made the trade independently, it does not absolve the Pakistani state of the responsibility of safeguarding its nuclear technology.”²²⁸ Kampani is absolutely correct. This chapter—and this thesis more broadly—should not be seen as an apologist tract justifying Khan and his network. The Pakistani state should be judged harshly for its recklessness. Nevertheless, the arguments marshaled by those who assume Pakistani state complicity are unimpressive. The North Korean case is problematic for analysts on both sides of the argument. The broad cooperation between Pyongyang and Islamabad created significant background

²²⁸ Kampani, “Second Tier Proliferation,” 112.

noise, which has often been interpreted (somewhat lazily) as if it were automatic proof of state knowledge of nuclear cooperation. This “static” is further complicated by the profound lack of information about the North Korean uranium program, let alone Khan’s assistance to it. The next chapter discusses a very different case. Khan’s assistance to Libya occurs in the context of a weak Libyan indigenous nuclear effort, a minor relationship between Islamabad and Tripoli, and significant evidence of profit to Khan and his associates.

V. TRAGIC AMBITION: LIBYA AND NUCLEAR OFF-SHORING

A. INTRODUCTION

From 1997 to 2003, A. Q. Khan assisted Libya in a bizarre nuclear effort, which Tripoli ultimately traded away for re-integration into the global community. Libya's decision to completely, verifiably, and irreversibly dismantle its nuclear effort spelled the end of Khan's nuclear enterprise. By pulling on the exposed Libyan thread, the whole network came unraveled. The components, materials, and reams of data turned over by Libya would prove indisputably Khan's involvement in a scheme to create a "turn key" nuclear facility. This audacious plan would import and manufacture all the physical capital necessary to make a nuclear bomb and train the technical personnel necessary to craft and maintain such an infrastructure. Khan would be rewarded richly for his daring concept. Libya was willing to pay \$100 million for such a capability.

Khan's boldness had served him for decades, allowing him to rise to the highest levels of society and earning him a cult of personality in Pakistan. In Greek tragedy, the protagonist's exaggerated self-confidence (hubris) results in retribution, and the character's downfall. Khan's Libyan effort was overreaching. The plan's ambition was necessitated not just by the size of the rewards, but by the erosion of Khan's position at home in Pakistan.

B. PAKISTAN'S REASSERTION OF CONTROL AT HOME

After the May 1998 nuclear tests, the Government of Pakistan began to think seriously about how to operationalize its nuclear arsenal. A "bomb in the basement" had required impressive scientific and technical efforts, but Pakistan had thought little about how to structure a system to command and control an operational nuclear deterrent. When Pervez Musharraf was promoted to the rank of general and made chief of army staff, he re-organized those portions of the military that had nuclear competency. He ordered the creation of a new Strategic Plans Division (SPD), which became functional in 1999.

For the first time, the military had an organization that could develop the organizational competency necessary to oversee Pakistan's sizeable nuclear weapons

complex. For the first time, it had senior military officers whose job it was to control strategic organizations, not just support them in an urgent race to the bomb. With the military coup in October 1999, the divided power of the 1990s was replaced by unitary rule. Though this may have been a setback for democracy, it eliminated the multiple power centers that Khan had relied upon to maneuver. By late 1999, lines of nuclear control in Pakistan were much clearer. There was one leader, Musharraf, to whom the heads of the strategic organizations reported to directly, and who also had access to a growing military bureaucracy whose mission was to implement his nuclear orders. Previously, Pakistani leaders had to rely on the strategic organizations for expertise and implementation.

Almost immediately, Khan clashed with SPD over his travels, statements to the media, and sales of KRL military equipment to foreign governments without official approval.²²⁹ Rumors of corruption at KRL, which had been around since the late 1980s, grew louder. By 2000, the National Accountability Bureau, an organization created by Musharraf after the coup, had built up a damning 700-page dossier on Khan's illicit wealth, though apparently it was not pursued.²³⁰ The Pakistan Inter-Services Intelligence also was growing more suspicious. Around this time, the ISI raided an aircraft chartered by KRL that was bound for North Korea. Though the search turned up nothing—apparently because other senior military officials warned Khan in advance—the search was representative that the tide had shifted against Khan.²³¹ Reportedly, the ISI expressed further concerns about Khan's travels and corruption at KRL to Musharraf in

²²⁹ Douglas Frantz, "From Patriot to Proliferator," *Los Angeles Times*, September 23, 2005; idem, "Pakistan's Role in Scientist's Nuclear Trafficking Debated," *Los Angeles Times*, May 16, 2005.

²³⁰ Ibid.

²³¹ There is some confusion about the date of the raid. A Pakistani news report, quoting an unnamed official, lists the date as between 1999 and 2001. "Re-Imposition of Sanctions Feared," *Dawn*, February 5, 2004. John Lancaster and Kamran Khan quote Lt. Gen. Khalid Kidwai (who may be the official referenced in the *Dawn* article) saying the raid occurred in 2000. Lancaster and Khan, "Musharraf Named in Nuclear Probe," *Washington Post*, February 3, 2004. Paul Watson and Mubashir Zaidi referenced Musharraf in a briefing to Pakistani journalists as saying early 2001. Watson and Zaidi, "Musharraf Pardons Scientist," *Los Angeles Times*, February 6, 2004. However, the FBIS translation of the televised portion of the press conference includes no discussion of a raid. See "Text of President Musharraf's News Conference 05 Feb," *PTV World* (Pakistan), February 5, 2005, FBIS Translated Text SAP20040209000072. Musharraf appears to confirm the 2000 date in an interview with the *New York Times*. However, the 2000 date is provided by a questioner, and initially Musharraf erroneously tells a story about an event that occurred in 2002 as if it had occurred in 2000. See "Interview with Pakistan President Pervez Musharraf, February 15," transcript of interview with *New York Times* staff, February 15, 2004, available online at <http://www.acronym.org.uk/docs/0402/doc23.htm>.

late 2000 and early 2001.²³² The Bush administration had also raised its rhetoric when talking to Pakistani officials. Robert Einhorn, U.S. Assistant Secretary of State for Nonproliferation, was reported to have told Lt. Gen. Khalid Kidwai, head of Pakistan's SPD, "Either you are not on top of this or you are complicit. Either one is disturbing."²³³

Some combination of these factors—clashes with SPD, reports of corruption, and louder concern by the United States—led Musharraf to force Khan's retirement in March 2001. A constellation of state forces was now arrayed against Khan. Khan had dealt with challenges from the PAEC and other "anti-Kahuta elements" for years, but this challenge was larger. If Khan's nuclear enterprise was to continue it would have to function with diminished support from Khan Research Laboratories and would require avoiding detection at home. Khan already had a vast network of international contacts upon which he could call. Perhaps the answer was to shift overseas.

C. KHAN'S ASSISTANCE TO LIBYA

Starting in 1997, Khan launched his most ambitious program of cooperation with Libya. Unlike Iran, Iraq, or North Korea, Libya had a limited indigenous nuclear infrastructure. In the early to mid-1980s, Libya had shopped around to European, Soviet, and Japanese suppliers for a uranium conversion facility, and eventually received a modular pilot-scale facility from a Japanese firm in 1986. From the late 1970s until the mid-1980s, Libya also received nuclear material, including over 2000 metric tons of uranium yellowcake and relatively small quantities of uranium hexafluoride, and equipment and training from European firms and the Soviet Union. The program lay relatively dormant throughout the late 1980s, but in July 1995, according to the IAEA, "Libya made the strategic decision to reinvigorate its nuclear activities, including gas centrifuge enrichment."²³⁴

²³² Frantz, "Pakistan's Role in Scientist's Nuclear Trafficking Debated," *Los Angeles Times*; also Kamran Khan, "Dr Qadeer Linked to N-Black Market," *The News International* (Karachi), January 28, 2004.

²³³ Barton Gelman and Dafna Linzer, "Unprecedented Peril Forces Tough Calls," *Washington Post*, October 26, 2004.

²³⁴ International Atomic Energy Agency, "Implementation of the NPT Safeguards Agreement of the Socialist People's Libyan Arab Jamahiriya," Report by the Director General to the Board of Governors, GOV/2004/12, February 20, 2004, 2-4; International Atomic Energy Agency, "Implementation of the NPT Safeguards Agreement of the Socialist People's Libyan Arab Jamahiriya," Report by the Director General to the Board of Governors, GOV/2004/33, May 28, 2004, 2-4; also George Jahn, "Diplomats: Japanese Company Sold Uranium Conversion Plant to Libya," *Associated Press*, March 12, 2004.

In 1997, two Libyans met with A. Q. Khan and B. S. A. Tahir in Istanbul, Turkey to ask Khan to supply centrifuge units to the Libyan nuclear program.²³⁵ Starting that year, Libya imported twenty complete L-1 aluminum centrifuges from Khan's network, along with most of the components for an additional 200 L-1 centrifuges. Significantly, the network apparently was unable or unwilling to provide the aluminum rotors and magnets necessary for these 200 unassembled units. At least one of these centrifuges had been used previously in Pakistan until 1987. In 2000, Libya imported two test L-2 maraging steel centrifuges from Pakistan. Both of these centrifuges had been used in the Pakistani nuclear program, and both were contaminated with highly enriched uranium particles. Libya placed an order for 10,000 additional L-2 centrifuges, with the first deliveries of the order arriving in December 2002.²³⁶

As discussed in the previous chapter, Khan's network apparently also transferred a total of 1.87 tons of uranium hexafluoride to Libya. B. S. A. Tahir told Malaysian police that a "certain amount" of uranium hexafluoride was shipped onboard a Pakistani plane to Libya in 2001.²³⁷ The fact that Khan was able to transfer nearly two tons of uranium hexafluoride in 2001—two years after SPD's creation—would seem to indicate there were still serious weaknesses in Pakistan's material protection, control, and accounting (MPC&A) practices—if the uranium came from Pakistan. If the uranium came from North Korea, it would raise questions about the responsible nuclear stewardship of the Pyongyang regime.

The complexity—and audacity—of the Libyan centrifuge order has been captured by David Albright, who notes that 10,000 centrifuges with 100 components each, means that a supplier network would have to procure or manufacture over a million components and ship them all to Libya.²³⁸ Some of these components must have been difficult for

²³⁵ Polis Diraja Malaysia, "Press Release by Inspector-General of Police in Relation to Investigation of Alleged Production of Components for Libya's Uranium Enrichment Programme," February 20, 2004.

²³⁶ "Implementation of the NPT Safeguards Agreement of the Socialist People's Libyan Arab Jamahiriya," May 28, 2004, 5-7.

²³⁷ Polis Diraja Malaysia, "Press Release by Inspector-General of Police in Relation to Investigation of Alleged Production of Components for Libya's Uranium Enrichment Programme," February 20, 2004; also David E. Sanger and William J. Broad, "Using Clues from Libya to Study a Nuclear Mystery," *New York Times*, March 31, 2005.

²³⁸ Albright quoted in Victoria Burnett and Stephen Fidler, "Animal Lover, Egoist, and National Hero," *Financial Times*, April 7, 2004.

Khan to procure through his traditional means. After all, in the Iranian, Iraqi, and North Korean cases, Khan had only supplied designs, a few hundred used components, and perhaps quantities of uranium hexafluoride. This was a problem that was literally orders of magnitude more difficult. Khan and Tahir responded by turning the existing front companies and procurement vehicles into more robust organizations with a capability to train foreign scientists and manufacturer certain products. Khan's biggest innovation—and his downfall—was to establish factories in third-party states and Libya to procure, assemble, and manufacture the necessary components and resources.

Workshops in Turkey served as European mini-hubs, from which Khan's network could procure and supply centrifuge motors, power supplies, and ring magnets from partially within the web of pan-European export controls. Importing subcomponents from Europe and elsewhere, these facilities assembled centrifuge motors and frequency converters necessary to spin the centrifuge at the high speeds necessary to separate different uranium isotopes.²³⁹ Interestingly, a shipment of these components was sent with false end-user certificates to Dubai, and was placed aboard a German-owned vessel, the *BBC China*, en route to Libya. As will be discussed below, when loaded onto the ship, it joined a larger shipment of centrifuge components from Malaysia that would gain notoriety when seized by Western governments in Taranto, Italy in October 2003. Highlighting the difficulties of interdiction, authorities removed the shipment from Malaysia, while the components from Turkey proceeded to Libya. Libyan authorities were kind enough to hand over the nuclear-related items to international inspectors upon their arrival in Tripoli.²⁴⁰

²³⁹ Polis Diraja Malaysia, "Press Release by Inspector-General of Police in Relation to Investigation of Alleged Production of Components for Libya's Uranium Enrichment Programme," February 20, 2004, http://www.rmp.gov.my/rmp03/040220scomi_eng.htm; David Albright and Corey Hinderstein, "Libya's Gas Centrifuge Procurement: Much Remains Undiscovered," *ISIS Issue Brief*, March 1, 2004, http://www.isis-online.org/publications/libya/cent_procure.html; and David Albright, "International Smuggling Networks: Weapons of Mass Destruction Counterproliferation Initiatives," Statement to the Senate Committee on Government Affairs, June 23, 2004, <http://hsgac.senate.gov/index.cfm?Fuseaction=Hearings.Testimony&HearingID=185&WitnessID=673&suppresslayouts=true>;

²⁴⁰ William J. Broad and David E. Sanger, "After Ending Arms Program, Libya Receives a Surprise," *New York Times*, May 29, 2004; Ian Traynor, "Western Agents Let Nuclear Equipment Slip Past to Libya," *Guardian* (London), May 29, 2004.

In South Africa, Khan's network was able to draw upon firms and individuals with connections to the now-defunct South African nuclear program. This latent nuclear knowledge was retained even after South Africa made a strategic decision to abandon its nuclear weapons program in the early 1990s. Apparently, Gerhard Wisser, a German-national living in South Africa, stumbled into the Khan network. He met B. S. A. Tahir at a dinner party in Dubai in 1999, who offered Wisser a lucrative commission if he could arrange for the manufacture of "certain pipe work systems." Wisser had previously done work for the South African nuclear program, and also had previously supplied vacuum pumps and other equipment to Pakistan in the 1980s. Wisser contacted an old business associate of his, Johan Meyer, who owned a South African engineering firm, Tradefin, and had previously worked for the South African nuclear program. Wisser and Meyer set about creating a massive steel system to feed and withdraw uranium hexafluoride gas into a centrifuge cascade. The massive system, referred to as "the beast" by Meyer, would have been two-stories in height, and filled eleven 40-foot shipping containers. The firm also attempted and failed to produce maraging steel rotors for the L-2 centrifuge. They received a specialized lathe from Gulf Technical Industries in Dubai in late 2000, but were unable to acquire the maraging steel necessary to make the rotors. As a result, they returned the lathe to GTI in December 2001. The lathe was later discovered in Libya.²⁴¹

The most publicized facility, however, was located in Shah Alam, Malaysia. The factory, established in 2001, only employed about thirty people. The plant was operated by Scomi Precision Engineering (SCOPE), a subsidiary of Scomi Group Berhad, a Malaysian oil and gas firm. Scomi claims with some credibility that they were unaware they had become part of the nuclear black market.²⁴² Starting in April 2002, Urs Tinner, son of a longtime Khan associate Friedrich Tinner, began consulting for SCOPE's factory at Tahir's request. Tinner arranged for the importation of lathes as well as cutting, turning, and grinding machines. The company made progress in machining some of the components necessary for a centrifuge. Between December 2002 and August 2003, 14

²⁴¹ This draws from the very good reporting of Douglas Frantz and William C. Rempel, "New Find in a Nuclear Network," *Los Angeles Times*, November 28, 2004; also Albright and Hinderstein, "Unraveling the A. Q. Khan and Future Proliferation Networks," 118.

²⁴² Scomi Group Berhad, "SCOPE's Press Statement on Its Contract in Dubai," news release, February 4, 2004, <http://www.scomigroup.com.my/publish/04news008.shtml>.

types of components were manufactured and shipped to Dubai. One should not overstate, however, the capabilities of the plant. After all, only fourteen of the approximately one hundred types of components in a centrifuge were manufactured in the plant. As the Malaysian police bluntly state, “As of now, no factory in Malaysia is capable of manufacturing a complete centrifuge unit, what more, the construction of hundreds or thousands of centrifuges.”²⁴³

There were limits to what the network could acquire abroad. Khan also decided to establish a facility within Libya to manufacture components difficult to procure elsewhere, and also to repair centrifuges that were damaged in the development and operation of an enrichment plant.²⁴⁴ Two British nationals, Peter Griffin and his son Paul, were implicated in the establishment of a workshop, called Project Machine Shop 1001. They were accused of purchasing and delivering furnaces and lathes to assist in the manufacturing of centrifuge components and arranging training in Europe for Libyan personnel.²⁴⁵

What is disconcerting is that after the interdiction of the *BBC China*, it became apparent that the Khan network had been compromised. Individuals associated with the network began a mad scramble to destroy evidence of wrongdoing, or possibly to sell it quickly to other interested customers. Centrifuge components, precision tools and parts for lathes, and perhaps seven valuable maraging steel rotors disappeared in 2003, as the network was collapsing. They may have been sold, or held in reserve for a “rainy day,” in the words of IAEA Director-General Mohammad ElBaradei, by members or states associated with the network.²⁴⁶

²⁴³ Polis Diraja Malaysia, “Press Release by Inspector-General of Police in Relation to Investigation of Alleged Production of Components for Libya’s Uranium Enrichment Programme,” February 20, 2004.

²⁴⁴ Albright and Hinderstein, “Libya’s Gas Centrifuge Procurement.”

²⁴⁵ Polis Diraja Malaysia, “Press Release by Inspector-General of Police in Relation to Investigation of Alleged Production of Components for Libya’s Uranium Enrichment Programme,” February 20, 2004. For his part, Griffin has vehemently denied a role in the endeavor and successfully sued the *Guardian* under Great Britain’s burdensome libel law. See Jan Colley, “Libel Damages for Engineer,” *Press Association*, May 3, 2005.

²⁴⁶ William J. Broad and David E. Sanger, “As Nuclear Secrets Emerge, More Are Suspected,” *New York Times*, December 26, 2004; and Douglas Frantz, “Vital Nuclear Parts Missing,” *Los Angeles Times*, April 22, 2005.

While the network of non-state actors is the most analytically interesting portion of the Libya story, it may not be the most significant aspect of Khan's cooperation with Libya. Libya received nuclear-weapons designs from the Khan network—supposedly as 'a bonus'—which were transferred inside of an Islamabad dry cleaner bag.²⁴⁷ Reportedly, Khan delivered the warhead plans to Libya in late 2001 or 2002.²⁴⁸ Many of the blueprints, designs, sketches and instructions found in Libya appear to have been copies of copies of copies. If the copies were passed on through middlemen, control of the information may have been irrevocably lost. As one European diplomat told the *Los Angeles Times*, "There is no limitation on a copy machine."²⁴⁹

D. MOTIVATIONS FOR ASSISTANCE

Why Libya? In the Iran case study, we could point to a doctrine—strategic defiance—to which influential policymakers subscribed, which might explain state approval for limited cooperation. In North Korea, there was a multi-year strategic relationship on ballistic missile development that could perhaps justify nuclear bartering. But in Libya, analysts were able to come up with few reasons the Pakistani state would want to assist Tripoli. People often refer to Libya's early support of Pakistan's nuclear program as a potential explanation for Pakistani technology transfer. However, there are two reasons this seems implausible. First, such support occurred in the mid-to-late 1970s, and beginning repayment in the late 1990s seems somewhat tardy. Second, and more importantly, after military dictator Zia ul-Haq hanged deposed Prime Minister Zulfikar Ali Bhutto in 1979, relations between Libya and Pakistan soured. Bhutto and Libyan President Moammar Gadhafi had formed a close relationship.

Estimates of Libyan payments to KRL of between \$50 and \$100 million seem insufficient for the risk the Pakistani government would be taking. In comparison, Saudi Arabia reportedly paid \$3 billion for between 36 and 40 Chinese CSS-2s.²⁵⁰ If the

²⁴⁷ William J. Broad, "Libya's Crude Bomb Design Eases Western Experts' Fears," *New York Times*, February 9, 2004.

²⁴⁸ Douglas Frantz, "A High-Risk Nuclear Stakeout," *Los Angeles Times*, February 27, 2005.

²⁴⁹ Douglas Frantz and Josh Meyer, "For Sale: Nuclear Expertise," *Los Angeles Times*, February 22, 2004.

²⁵⁰ Erika Pontarelli, "U.S. Hails Libyan Nuclear Weapons Recovery as 'Important Victory,'" *Agence France Presse*, March 16, 2004; Reuters, "Libya paid Khan \$100m for nuclear technology," *FT.com*, March 16, 2004.

Pakistani state was trying to supplement its defense and nuclear budget, it was getting chump change. The timeline of transactions only reinforces the point. Much of the cooperation began after 2001. In other words, collaboration and payments increase after 9/11, just when huge volumes of U.S. aid began flowing to Pakistan to reward its role in the Global War on Terrorism. It seems unlikely that the leadership in Islamabad and Rawalpindi would endanger that new relationship in exchange for a relatively small payout from Tripoli. The timeline is also important because cooperation began increasing just after Khan was removed as head of KRL.

It appears that Khan was primarily motivated by greed, and perhaps to a lesser extent out of some misguided desire by Khan for pan-Muslim comity. His Swiss, South African, Turkish, and British partners seem to have been squarely and solely motivated by personal greed. This should make us reflect back, however. Analysts may push for larger, strategic rationales, when instead, micro-level, individual decisions and motivations may have decisive strategic effect.

E. OLD FRIENDS AND NEW CUSTOMERS

The Libyan episode revealed a nuclear underworld that Khan was able to draw upon to launch his ambitious scheme. What is so disconcerting is that Western governments knew of many of these individuals and entities, and their potential illicit operations. National and international regulators had at least a partial picture of many of the key nodes in the Khan network by the 1980s.

Friedrich Tinner, father of Urs Tinner, first came under U.S. Defense Department scrutiny in the 1970s while working at a Swiss firm specializing in vacuum technology, and throughout the 1980s and 1990s firms connected with Tinner were suspected of illicit sales to Iraq.²⁵¹ Peter Griffin, alleged to have been involved in setting up the Libyan workshop to manufacture and repair difficult centrifuge components, was investigated for the first time in the 1970s. Similar tales could be told about others. Concerns had been

²⁵¹ Frederick Lamy, "Export Control Violations and Illicit Trafficking by Swiss Companies and Individuals in the Case of A. Q. Khan Network" (Geneva: Geneva Center for Security Policy, August 19, 2004), 3; Burnett and Fidler, "Animal Lover, Egoist, and National Hero," *Financial Times*, April 7, 2004.

raised during the 1980s for three Germans suspected of proliferation activities: Heinz Mebus, Otto Heilingbrunner, and Gotthard Lerch.²⁵²

Perhaps the most egregious case involved the Dutch national Hank Selbos. Slebos went to school with Khan in the 1960s, first traveled to Pakistan in 1976, was first warned about exports to Pakistan in 1980, was first caught with illegal exports in 1983, was imprisoned for one year for those illegal exports in 1985, was noticed meeting with Khan in the Netherlands in 1988 (Khan was in the Netherlands illegally), continued to have difficulties with Dutch regulators for repeated sales to Pakistan in the late 1990s, and was a sponsor of a Khan Research Laboratory symposia in 2003. He has been implicated of working with the Turkish and Malaysian firms supplying the Libyan program, and apparently met with Libyan officials along with Khan at least once in Casablanca in 1998.²⁵³ Despite the four-decade-long association between Slebos and Khan, Dutch and international authorities were not able to stop the flow of controlled technology. David Albright and Corey Hinderstein have noted, “The failure of these NSG [Nuclear Suppliers Group] countries to stop the illicit manufacturing of centrifuge components is one of the most embarrassing aspects of this scandal.”²⁵⁴

Many of these individuals had been involved with the Pakistani program from the beginning. Khan’s effort to craft an elaborate network to procure proscribed items had paid an extra dividend. Khan had simultaneously crafted a network capable of nuclear exports, as well as imports. The same skill set (engineering, manufacturing, logistics, and finances) was needed to do both jobs. And characters willing to assist a rising nuclear state for a profit, would likely be willing to assist other motivated buyers achieve their objectives. As the following figure demonstrates, the procurement network created in Europe in the 1970s and 1980s became the backbone of the proliferation network of the 1990s and 2000s (see figure 2, next page).

²⁵² Heilingbrunner and Lerch worked together at Leybold, a German firm. Mebus worked for a different company, CES Kalthoff GmbH.

²⁵³ Joop Boer, et al, *A. Q. Khan, Urenco, and the Proliferation of Nuclear Weapons Technology*, 16-20; Mark Hibbs, “European Suspects in KRL Case May Have Previous Involvement,” *Nucleonics Week*, February 5, 2004; Mark Hibbs, “Dutch Prosecutors to Charge Slebos with Violations Involving KRL,” *Nucleonics Week*, May 13, 2004; “Pakistan’s Nuke Scientist Khan, Colleagues Met Libyans,” *Japanese Economic Newswire*, March 18, 2005.

²⁵⁴ Albright and Hinderstein, “Unraveling the A. Q. Khan and Future Proliferation Networks,” 120.

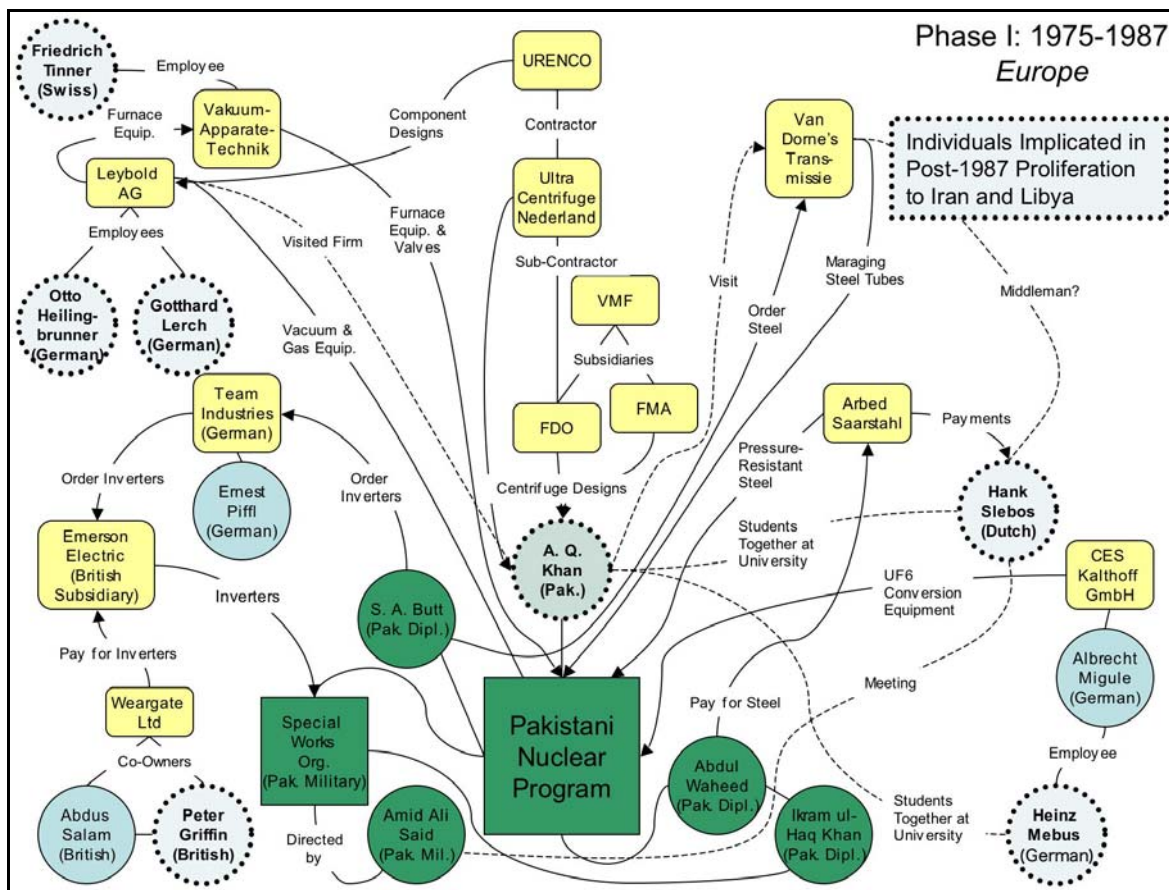


Figure 2. Individuals Implicated in Khan's Nuclear Network

F. GOING DOWN WITH THE SHIP: THE *BBC CHINA*

By 2000, in the early stages of Khan's assistance to Libya, the U.S. and British intelligence agencies had evidence of shipments of centrifuge technology from Khan's network to Libya.²⁵⁵ By 2002, the British Joint Intelligence Committee had concluded that Khan had moved his operations base from Pakistan to Dubai, and also noted the use of production facilities in Malaysia. More importantly, the British had concluded, "A. Q. Khan's network was central to all aspects of the Libyan nuclear weapons program."²⁵⁶ At some point, the United States attained evidence that Libya had acquired a nuclear weapons design from Khan, apparently through covert operational daring.²⁵⁷

²⁵⁵ Commission on the Intelligence Capabilities of the United States Regarding Weapons of Mass Destruction, *Report to the President of the United States* (Washington, D.C.: GPO, March 31, 2005), 257 [hereafter, *WMD Commission Report*]; and Lord Butler, Chairman, Report of a Committee of Privy Counselors, *Review of Intelligence on Weapons of Mass Destruction* (London: The Stationary Office, 2004), 17 [hereafter, *Butler Commission Report*].

²⁵⁶ *Butler Commission Report*, 18.

²⁵⁷ *WMD Commission Report*, 257.

U.S. and British intelligence agencies had penetrated the network by this point. They were probing, seeking to learn the extent of the enterprise. In a September 2004 speech, Director of Central Intelligence George Tenet reportedly told an audience, “Working with British colleagues, we pieced together his subsidiaries, his clients, his front companies, his finances and manufacturing plants. We were inside his residence, inside his facilities, inside his rooms. We were everywhere these people were.”²⁵⁸ Khan’s network was not just being bugged, it also had been infiltrated by human spies.²⁵⁹ There has been some speculation that B. S. A. Tahir might have been a U.S. informant.²⁶⁰

The British Butler Commission noted the tension between observing and disrupting. “Action to close down the network had until this stage been deferred to allow the intelligence agencies to continue their operations to gather further information on the full extent of the network. This was important to gain a better understanding of the nuclear programs of other countries which Khan was supplying. But Khan’s activities had now reached the point where it would be dangerous to allow them to go on.”²⁶¹ This determination to act was made in early 2003.

A decision was made to interdict the centrifuge and other components coming from the Shah Alam facility in Malaysia on their way to Libya. On October 4, 2004, the German-flagged vessel, the *BBC China*, was diverted to port in Taranto, Italy, in an action coordinated by U.S., British, German, and Italian authorities. Five containers full of sensitive components—components that had been tracked from their point of origin by U.S. and British intelligence agencies—were off-loaded in Italy.²⁶² As noted earlier in this chapter, other containers aboard the *BBC China* were also full of nuclear-related components, this time from Turkish companies, and continued their journey to Tripoli.

²⁵⁸ Douglas Jehl, “C.I.A. Says Pakistanis Gave Iran Nuclear Aid,” *Washington Post*, November 24, 2004.

²⁵⁹ *WMD Commission Report*, 519.

²⁶⁰ Bill Powell, et al, “The Man Who Sold the Bomb,” *Time*, February 14, 2005.

²⁶¹ *Butler Commission Report*, 18.

²⁶² *Ibid.*, 19; also Polis Diraja Malaysia, “Press Release by Inspector-General of Police in Relation to Investigation of Alleged Production of Components for Libya’s Uranium Enrichment Programme,” February 20, 2004.

The U.S. and Britain had been engaged for months in talks with Libya, seeking for Tripoli to forgo its weapons of mass destruction programs. The interdiction of the *BBC China*, combined with other signals from U.S. and British interlocutors, demonstrated to the Libyans that their nuclear effort had been compromised considerably. Two months after authorities removed the containers from the *BBC China*, Libya made a strategic decision to verifiably, comprehensively, and irreversibly dismantle its weapons of mass destruction programs. In doing so, Libya provided U.S. and international investigators with significant new data that could be used to attack Khan's network. In the words of U.S. Undersecretary of State for Arms Control and International Security Robert Joseph, "Interdiction of the *BBC China*, followed by cooperation from the United Arab Emirates, South Africa, Malaysia, Turkey and several European countries led to the destruction of the Khan network and the on-going investigation, prosecution or imprisonment of many of its leading members."²⁶³

Pulling on the Libyan thread led to Pakistan and Khan, the individual. In January 2004, U.S. Secretary of State Colin Powell called President Pervez Musharraf. In Powell's words, he told Musharraf, "We know so much about this that we're going to go public with it, and within a few weeks, okay? And you need to deal with this before you have to deal with it publicly."²⁶⁴ Khan and his close associates were brought into custody by the Pakistan government.

Dr. A. Q. Khan appeared on television screens across Pakistan on February 4, 2004. The tone of his highly choreographed presentation was immediately clear to the audience at home and around the world. "It is with the deepest sense of sorrow, anguish, and regret that I have chosen to appear before you in order to atone for some of the anguish and pain that has been suffered by the people of Pakistan on account of the extremely unfortunate events of the last two months."²⁶⁵ Khan was pardoned the

²⁶³ Joseph, "Applying the Bush Administration's Strategy to Combat Weapons of Mass Destruction to Today's Challenges," Prepared Remarks to the Fletcher School Conference on the Proliferation of Weapons of Mass Destruction, *Federal News Service*, October 21, 2005.

²⁶⁴ Secretary Colin Powell, Interview at the Christian Science Monitor's Newsmaker Press Briefing Luncheon, December 21, 2004, <http://www.state.gov/secretary/former/powell/remarks/39999.htm>.

²⁶⁵ "Text of Dr Abdul Qadeer Khan's Statement Seeking Public Apology," transcribed text from Pakistan TV 1 (Islamabad), February 4, 2004, *FBIS Report no. SAP2004020400069*. Also Rafiqat Ali, "Dr Khan Seeks Pardon," *Dawn* (Karachi), February 5, 2004.

following day by President Musharraf—a pardon conditional on his continued cooperation with the investigation.²⁶⁶ Musharraf’s government placed Khan under virtual house arrest. Khan had reached his denouement.

G. CONCLUSION

With Khan’s arrest, confession, and pardon, the A. Q. Khan network ceased operations. In Secretary of State Powell’s words, “All I know is A.Q. Khan is not doing what A.Q. Khan was doing last year. And that is a major, major achievement.”²⁶⁷ Khan’s network of operatives, middlemen, technicians, and logisticians was thoroughly disrupted by the wave of interdictions, investigations, raids, and arrests that became first publicly visible when the *BBC China* was diverted in October 2003. Many were arrested, but some of his associates have almost certainly escaped capture. Some of Khan’s knowledge, expertise, and physical components almost certainly remains available for the right price. Nuclear weapons designs may still be accessible to motivated buyers. We all must live with the legacy of A. Q. Khan. The next, and concluding, chapter more fully considers the implications of the Khan network for how we think about new nuclear states and the policies that we fashion to deal with past, present, and future proliferation.

²⁶⁶ “Text of Musharraf’s TV News Conference,” translated text from PTV World (Islamabad), February 5, 2004, *FBIS Report no. SAP20040209000072*.

²⁶⁷ Secretary Colin Powell, Remarks En Route to Kuwait, March 18, 2004, <http://www.state.gov/secretary/former/powell/remarks/30562.htm>.

VI. CONCLUSION

A. INTRODUCTION

From 1976 to 2004, Dr. Abdul Qadeer Khan was at the center of the global nuclear black market. He was not the first to benefit from the illicit trade in destructive technologies, but he accelerated the consolidation of the market. He did much to spread nuclear weapons technology. He removed key obstacles in Pakistan's successful quest for nuclear weapons. He provided assistance to Iran, North Korea, and Libya. Significantly, he allowed Iran and North Korea to continue their pursuit of nuclear ambitions after they encountered dead ends in their attempt to acquire unsafeguarded plutonium. He may have allowed Tehran and Pyongyang to continue with nuclear efforts that were not readily visible by Western intelligence agencies. He offered nuclear assistance to Iraq, and perhaps others.

This conclusion reviews the factual arguments made throughout the thesis. Next, it provides theoretical observations on the importance for the Khan nuclear network for the academic debate on nuclear proliferation. It provides policy implications and recommendations for a post-Khan world. Finally, it concludes by offering indicators that might point to the next "A. Q. Khan."

B. RESEARCH SUMMARY

1. What Technology and Material Did Khan Provide to His Clients?

A. Q. Khan and his network did not have access to the entirety of a nuclear weapons program. Khan did control, however, more components than any non-state actor in history. The list of items available to Khan and his network approaches, but does not quite reach, the level of a "turnkey" nuclear program. He had access to uranium hexafluoride, which he provided to Libya and perhaps North Korea. His specialty was centrifuge technology, components, and designs. He provided used centrifuge parts to Iran, North Korea, and Libya. With regards to Iran, he provided significant quantities of disassembled centrifuges. Often, these sample centrifuges were more useful for the target state as a template than as a functioning device. In addition to the sample machines, Khan and his network provided detailed blueprints and designs of centrifuges. Khan also provided valuable information about which components, parts, and materials to purchase

in order to create a successful centrifuge program. This “shopping list” appears to have allowed Iran and North Korea to go directly to European and Asian firms to obtain key nuclear-related goods, circumventing the global export control regime in the process. Significantly, in at least the Libyan case, he provided nuclear weapons designs and instructions. The material Khan provided on nuclear warhead design was not a simple blueprint, but a detailed “how to” packet, apparently with descriptions of both manufacturing processes as well as design specifications. Finally, Khan provided consulting services, to at least his Iranian and Libyan clients.

In the Libyan case, the consulting reached profoundly ambitious heights. Khan was at the center of virtually all aspects of the Libyan nuclear program. Khan moved beyond just the provision of discarded centrifuges and designs. Libya did not have the nuclear infrastructure to utilize them. Khan would have to create the infrastructure, both in Libya and also in off-shore factories in Turkey, South Africa, Malaysia, and other countries. He appears to have encountered bottlenecks in his scheme. The numbers of ring magnets and centrifuge motors provided to Libya were quite small. Some aspects of nuclear know-how appear quite difficult for non-state (and non-Western) actors to manufacture.

2. How Significant Was Khan’s Assistance?

Khan was not selling nuclear weapons. None of his clients have successfully constructed highly enriched uranium-based nuclear explosives based on Khan’s assistance. What Khan did was to shorten timelines, perhaps dramatically. In the Iranian and North Korean cases, Khan provided seed technology. Khan probably could not have acquired centrifuge technology for Pakistan without information from URENCO and other European firms. Khan passed that URENCO-based technology onto Tehran, Pyongyang, and Tripoli. These states may have developed centrifuge technology without Khan. After all, Brazil has a centrifuge effort quite distinct from Khan. Khan almost certainly shortened the research and development timelines of his clients: probably by years rather than months. These states did not have to go through the trial-and-error process of centrifuge design. Instead, they had a validated design that they could seek to duplicate and manufacture on mass scale.

Even successful construction of a centrifuge—or a hundred, or a thousand centrifuges—is only one crucial part of the puzzle. First, uranium hexafluoride must be created by the ton. There is not evidence that Iran, North Korea, or Libya had mastered this step, though Iran and Libya had previously acquired non-Khan foreign assistance on a uranium conversion facility. Second, centrifuges must be constructed into a large cascade of machines, slowly enriching U-235 from U-238. These cascades must operate for months to create sufficient material for a nuclear device. Their operation draws huge quantities of power from the electric grid. Flawed centrifuges may break, spinning at thousands of rotations per minute, launching shrapnel into the cascade. Poor quality uranium hexafluoride will slow the cascade in its functioning. The cascade may also be discovered by outside groups, as occurred with the nascent Iranian facility at Natanz. Finally, once a state has acquired sufficient quantities of fissile material, it must be re-converted into uranium metal and machined into a nuclear explosive device. Khan apparently provided, or at least offered, both re-conversion and nuclear weapons design assistance. None of his clients appear to have gone this far down the nuclear path.

3. To What Degree Was Khan a Rogue Actor, or an Agent of the Pakistani State?

One of the most challenging questions has been ascertaining the degree of knowledge or complicity of Pakistani leaders in Khan's nuclear enterprise. Key leaders, most significantly army chief Gen. Mirza Aslam Beg, may have been predisposed toward nuclear cooperation, particularly with Iran. These leaders may have provided a policy opening for Khan in the late 1980s to begin his profitable nuclear assistance. This thesis has argued, however, that Khan likely exceeded whatever mandate he received from Pakistani leadership. In particular, it is confusing that Khan's nuclear assistance continued after these individuals left the scene. It is confusing, for instance, that Khan's nuclear trade with Iran was increasing at the same time as Pakistan's relationship with Iran was souring.

Open closer examination, the "proof" of state authorization for Khan's assistance to North Korea appears much less definitive. Images of Pakistani C-130s on a North Korean runway are insufficient. The extensive cooperation on conventional and ballistic missile technologies created a high "signal-to-noise" problem, for both foreign

intelligence analysts and, perhaps, for the Pakistani overseers themselves. The strategic rationales for cooperation are also less convincing when examined in detail. Why would Pakistan be forced to barter sensitive nuclear technologies for decades-old liquid-fuel missile technology? Why just Pakistan, when North Korea was selling the same technology to states all around the globe?

Finally, what strategic rationale justified Khan's Libyan trade? If the Pakistani state was seeking income, it was selling its services fairly cheaply. It was also engaged in a very risky business. As Khan's Libyan sales were increasing, Pakistan was receiving massive amounts of aid for its role in the global war on terrorism. Selling nuclear technology to Tripoli could endanger that aid, and the interests of the Pakistani state. Khan's nuclear off-shoring was an attempt to provide Libya with sensitive nuclear technology, while simultaneously avoiding strengthening military oversight at home.

Khan appears to have been motivated by personal profit and pride. He wanted to demonstrate that he could defy the global nonproliferation regime, that he could defy the United States, and that he could defy the weak controls at home. For nearly three decades, Khan was a force unto himself.

The Pakistani state shares significant responsibility in Khan's nuclear enterprise. Its decision in 1976 to provide Khan with broad autonomy and financial control allowed for Khan to create his nuclear fiefdom. The Pakistani state apparently had weak control of its centrifuges, centrifuge designs, nuclear weapons designs, and perhaps uranium hexafluoride. Pakistan always felt that this man who had given Pakistan so much would not betray Pakistan. The controls around him were always weaker than the controls around anyone else. The controls on the rival Pakistan Atomic Energy Commission were much stricter, and perhaps as a result the PAEC has not been implicated in the nuclear black market.²⁶⁸

C. THEORETICAL OBSERVATIONS

The A. Q. Khan network provides a wealth of data for the optimism-pessimism debate. The optimist argument was always premised on rationality, the unitary nature of

²⁶⁸ Two retired PAEC scientists do appear to have discussed nuclear weapons technology with al Qaeda, in a very serious breach. However, this appears to be a relatively isolated breakdown in the post-employment personnel reliability program.

a nuclear weapons state, and a relative ease of control of nuclear technology. The stakes were so high, the optimists argued, that reasonable states would expend the necessary effort to control their nuclear technology. The three cases studied in this thesis, however, should cause even the most ardent optimist to pause. In the Iranian case, for instance, Khan provided significant nuclear assistance to a neighbor with which Pakistan has had troubled relations. There are two possible ways to read this assistance. If this was a realist attempt to cement an alliance, it appears to have been unsuccessful. Indo-Iranian relations are better than Indo-Pakistani relations. If Iran does acquire a nuclear device, Pakistan will be responsible for its own deterioration in security. Alternatively, perhaps it was Khan acting as an individual for personal profit. This would call into question the optimist argument that states can relatively easily control sensitive nuclear technology and will do so because of the potential costs involved.

As this study of the Khan network indicates, there are limits to how useful “the state” is as an analytical concept. What does it mean that the Pakistani state was aware of Khan’s commerce? In particular, decision-making about the Pakistani nuclear program has been highly personalized since its inception. The Pakistani state, per se, did not make nuclear decisions. Individual Pakistani leaders—Zulfikar Ali Bhutto, Mohammad Zia-ul-Haq, Ghulam Ishaq Khan, Mirza Aslam Beg, and Abdul Qadeer Khan—made nuclear decisions. They often made them quietly. They sometimes circumvented the rudimentary oversight bodies that did exist. More research should be done on decision-making in such personalized and de-institutionalized environments. The Khan episode sensitizes us to the fact that states are not “ping pong balls” bouncing around in reality. The internal workings, down to personality disputes between key individuals, can have dramatic impacts on the observed behavior.

The Khan episode appears to erode the optimist argument in three ways. First, it underlines that states have other motivations besides minimizing nuclear risks. A state will often have to balance very concrete security concerns against hypothetical nuclear safety. This is particularly true in the early years of a nuclear program. The program was likely initiated as the result of a fairly intense security threat—if not, the need to internal balance would not have been felt in the first place. Simultaneously, the state will probably want to keep information about the nuclear weapons program very tightly held

and compartmentalized, to prevent secret information from reaching the adversary and other interested outsiders. Secrecy and speed are in conflict with safety. National security managers, particularly in the early years of the program, are likely to have significant experience with cultures of secrecy and cultures of results, but may have much less experience with cultures of safety.

The second challenge to the optimist argument has to do with the ease of control. Optimists had argued that the state security apparatus could easily control the relatively small weapons programs of new nuclear states. But how does a state establish a personnel reliability program when it never has had one in the past? How does a state police its nuclear establishment when the program is so sensitive that perhaps the regular intelligence agencies cannot be entrusted with program details? How does it establish export controls, particularly when the scientific competency resides in the scientific organizations that need to be regulated? Pakistan confronted these challenges and it made several mistakes. Khan and his top associates at the laboratory were not screened by security services. Khan's travels were not closely scrutinized. Shipments into and out of the country appear not to have been searched. Key security personnel at Khan Research Laboratory reported to Khan directly, and their financial well being depended on Khan's approval.

The third challenge is largely theoretical at this point. Khan's network lowered the barriers to entry into the nuclear business. He cut years of the research and development timetables of his client states. Libya would not have had a nuclear weapons program without Khan's assistance—he was involved in all key aspects of the effort. He enabled a state with limited infrastructure and scientific expertise to become a nuclear aspirant. The optimist argument argues that the barriers to entry of nuclear acquisition will screen out the least stable states. While the obstacles to nuclear possession are still quite high, as they are lowered, the self-selection optimist argument will be weakened.

D. POLICY IMPLICATIONS

This study has highlighted a number of policy challenges that will confront decision-makers for some time. First, the technological piece of the nonproliferation puzzle is growing more complicated. Precision manufacturing capabilities are available in more and more countries. Information about controlled technologies is also more

widely available. Globalization eases travel and commerce. Specialists from the developed world can travel to the developing world with blueprints on a hard disk. They might program a lathe for a few days, and then return home to their cottage for the weekend. A firm in Malaysia could and did manufacture parts for a subsidiary in Dubai that turned out to be controlled centrifuge components. The subsidiary in Dubai did not know the ultimate consumer for the products, only a front company. The shipping firm carrying the parts from Dubai to Tripoli did not realize it had sensitive cargo. The intelligence agencies that pulled the containers off of the ship did not realize that there were other containers on the same ship, carrying sensitive components from a Turkish company that were also destined for the same Libyan bomb program.

Globalization and technological diffusion have complicated the problem, but the old problem did not go away. European firms and some of the same individuals are still selling proscribed technologies to nuclear programs. This is partially because of increased sophistication by client states—using front companies, false end-user certificates, and other deception techniques. It is partially because of the lethargy of bureaucracies and the problem of out-of-date export control lists. And it is also partially caused by the high profits that can be made in selling controlled technologies.

Governments that learn of illicit procurement are confronted with a policy challenge: do they watch or do they act? There is a tension between action and observation. In other words, policymakers aware of the transfer of WMD technology, expertise, or material have the choice of watching that transfer to gain a better understanding of both the suppliers and consumers, or they can move to prevent or interdict the transaction. The principle challenge is that premature action is unlikely to have decisive effect on either a proliferation network or a procurement effort. Greater understanding of the structure of a network—achievable only through watching—is often necessary to impair its function. Of course, waiting too long could allow a potential threat to mature, risking the security of the United States and other countries.

Taking action is also challenging. Intelligence that is collected about an unscrupulous merchant, for instance, has to be converted into something usable. If the merchant is in the United States, the intelligence might have to meet legal standards, or

lead to other evidence that does meet such standards. This might delay action for months. If the merchant operates in a foreign country, the problem is complicated further. Will sharing intelligence with a foreign government endanger the source? Will that government take action? Will that government value its own commercial interests over a hypothetical risk, particularly a risk that is likely to be more acutely felt by the United States than the foreign government?

This thesis wrestled with Pakistani state complicity because it has significant policy implications. Some policymakers intuitively divide the world into good and bad states. Good states do good things and bad states do bad things. Many analysts look at Pakistan as an archetypical “bad state,” admittedly one that gets away with it. The policy recommendations that flow from that conclusion are about changing the nature of the state. They might be punitive, hoping to raise the costs of bad behavior. For instance, many believe Pakistan should be sanctioned for its proliferation record, particularly if access to A. Q. Khan is not provided to U.S. investigators. Alternative policy proposals might seek to reform Pakistan, hoping to change the nature of the state from the inside. Most Indians and many others believe that Pakistani behavior will not conform to global norms so long as the military dominates Pakistani politics. These same analysts blame the military for Pakistan’s dismal proliferation record.

This thesis has presented evidence of a less Manichean world. If Khan’s network flourished because of failures of Pakistani command and control, the policy solutions are very different. Policymakers must look more closely at assisting new nuclear states with their safety and security arrangements. This will be tricky. New nuclear states, who prize secrecy so much, are unlikely to share extensive data with outsiders, particularly outsiders who might be direct threats to new nuclear programs. Assistance with personnel reliability programs may provide new nuclear states with greater certainty about their positive and negative control. Hypothetically, such confidence might lead states to deploy their nuclear forces at a higher state of readiness. Given the significant other costs of such deployment, however, it seems unlikely that concerns about personnel are the only obstacle to deployed and ready nuclear arsenals. This potential risk must be weighed against the proven risk of what insiders can do when they operate outside of state oversight and control.

E. CONCLUSION: THE NEXT A. Q. KHAN?

The A. Q. Khan affair was a significant failure for all involved. The Pakistan government provided Khan too much authority, it had minimal nuclear oversight, and was slow to react to internal and external warnings that Khan was up to no good. The United States was too slow in realizing Khan's growing danger, despite having intimations of his nuclear trade by the early 1990s. Europe was too slow in policing its own individuals and firms, which supplied Khan from 1976 until 2004. There is enough blame to go around. By outlining those mistakes, and examining the causes of those failures, I hope that they will not be repeated. The problem is not going away, however. If anything, globalization and the diffusion of WMD-relevant technology have only complicated the policy problem. Each new WMD program could hold another potential A. Q. Khan.

What indicators or characteristics should concern policymakers and intelligence analysts in the future? Khan had broad financial autonomy. He had great flexibility in how he operated his procurement network. He could acquire and ship components with little external oversight. He had good connections with foreign suppliers. He was not personally screened by intelligence services, nor were his close associates. He was a proud and greedy man. His wealth was well known, despite his relatively modest government salary. He had strong rivalries with other program managers. He jockeyed with them for public esteem, esteem which he coveted deeply. The public esteem also insulated him from political pressure and oversight. His independence was reinforced further by the turbulent nature of Pakistani politics, particularly during the troubled 1990s. Finally, he was deeply proud of being able to defy the discriminatory and Western-led export control regime. Do these conditions apply elsewhere? If so, the next A. Q. Khan may already be out there.

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